ORIGINAL

0000125459

RECEIVED

2011 MAY 26 A 11:04

AZ CORP COMMISSION
DOCKET CONTROL

State Regulation

Mail Station 9708
PO Box 53999
Phoenix, Arizona 85072-3999
Tel 602-250-2709
Susan.Casady@aps.com

Arizona Corporation Commission
DOCKETED

MAY 26 2011

DOCKETED BY

May 26, 2011

Docket Control
Arizona Corporation Commission
1200 W. Washington
Phoenix, AZ 85007

RE: Informed Perception Project; Docket No. E-01345A-08-0172

As a result of a commitment made by Arizona Public Service Company at the Special Open Meeting on December 9, 2009, APS agreed to conduct deliberative polling of its customers during 2010. Attached please find the Arizona State University Morrison Institute for Public Policy report with the results of the Informed Perception Project conducted for Arizona Public Service Company.

If you have any questions regarding this information, please contact me at (602)250-2709.

Sincerely,

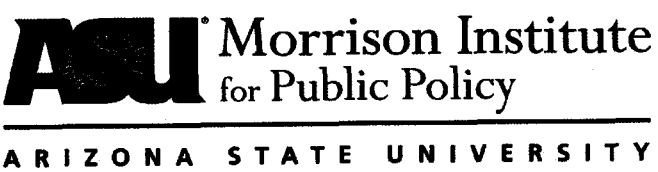
Susan Casady

Susan Casady

SC/sl
Attachment

APS Informed Perception Project Report

Prepared by:



May 2011

Morrison Institute contributors:

David Daugherty
Erica Edwards
William Hart
Eric Hedberg
Monica Stigler
Christine Totura
Nancy Welch

THE APS INFORMED PERCEPTION PROJECT

EXECUTIVE SUMMARY

Morrison Institute for Public Policy at Arizona State University led a public policy research team in a project to provide insight into priorities and preferences of Arizona residential utility customers (hereafter referred to as "participants") for the development of future energy resource alternatives. Through the combination of quantitative[1] and qualitative[2] research, the project addressed four basic questions:

1. What are the energy preferences and priorities of residential utility customers among the resource choices?
2. What factors influence these preferences and priorities?
3. How does energy education affect attitudes and opinions about energy and energy planning?
4. Do changes in opinions and attitudes persist over time, or do they revert to their previous position?

Following exposure to an educational energy booklet (Energy Briefing Book) and participation in the one-day Energy Forum event held December 4, 2010, several primary findings emerged, highlighted below.

Highlights

Some Willingness among Customers to Pay to Address Energy Issues

Given a reason for doing so – quicker development of renewable energy sources or job creation, for example – most participants would be willing to absorb an increase in their electrical rates. However, they are more receptive to a fixed-dollar amount than to a percentage of their bill. About one-quarter of participants, on the other hand, oppose any rate increase.

Development of Renewable Energy

There is broad support for the development of renewable energy – particularly solar power. In the first survey (T1), administered before participants had been given any energy education in the form of the Energy Briefing Book or at the Energy Forum, 94% wanted an increase in the use of solar as a part of the energy portfolio and 82% wanted an

[1] One telephone interview at the beginning of the project and one at the end, and two self-completed questionnaires administered at a daylong Energy Forum

[2] Three 1- to 1½-hour small group discussions at the daylong Energy Forum

increase in the use of wind power. By the end of the study (T4), the percent that advocated for increased use of solar and wind power were 94% and 78%, respectively. Further, "getting electricity from sources that will never be used up" was ranked as the most important issue from among the 10 energy issues tested. The second most important issue was related to renewable energy as well, "minimizing air pollution."

Figure 1 summarizes the findings from the four surveys (T1-T4), measuring how important participants perceive each of the 10 energy issues listed. The graph is based on the percentage of participants who ranked the importance of each energy issue a 4 or a 5 on a 5-point scale, with 5 representing extremely important.

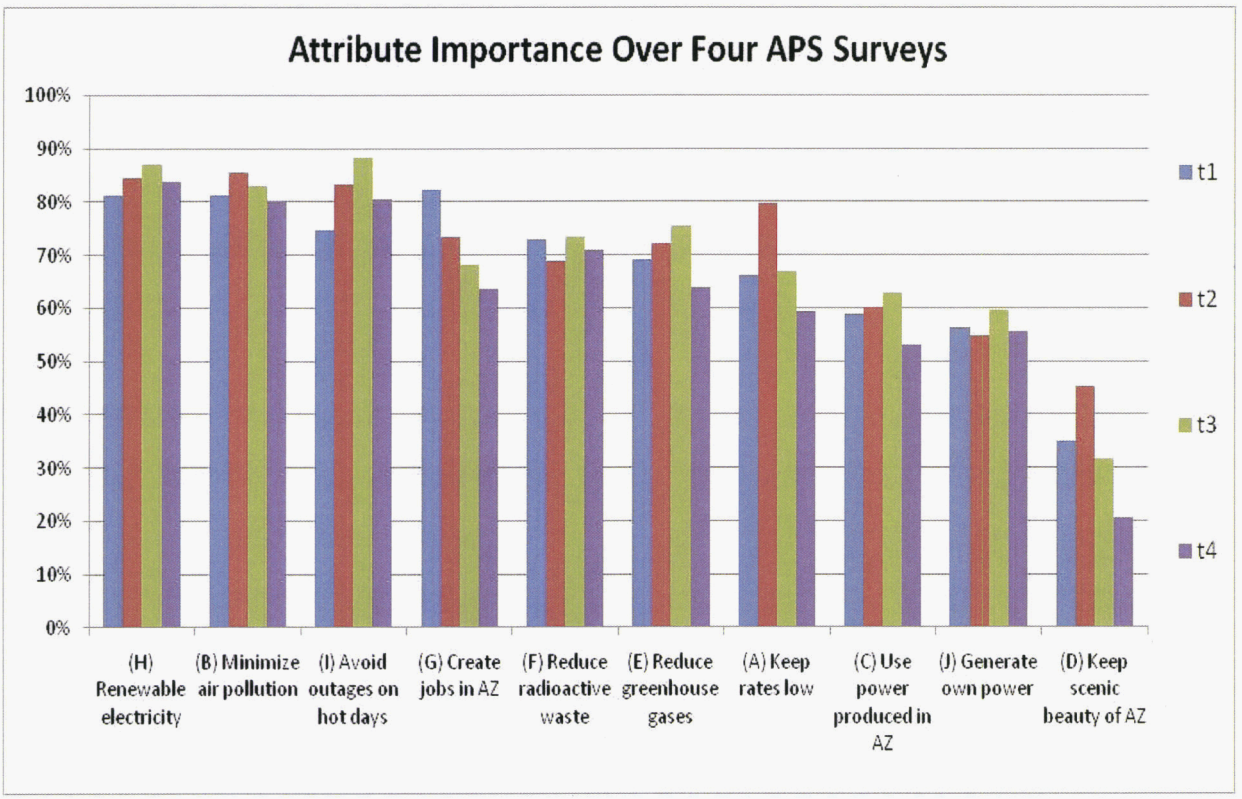


Figure 1.

Reduced Coal Usage

Of the eight energy sources tested – coal, energy efficiency, geothermal, hydro, natural gas, nuclear, solar and wind – coal was perceived as the most harmful to the environment, although it was also perceived as one of the most dependable and lowest-cost energy sources. At the beginning of the study (T1), 74% of participants reported wanting a reduction in coal usage to produce electricity (see Figure 2: Perceived Energy Usage Across Tests). By the end of the study (T4), 59% wanted coal usage reduced. Across all survey administrations, coal is the only source in which participants favored a reduction in use.

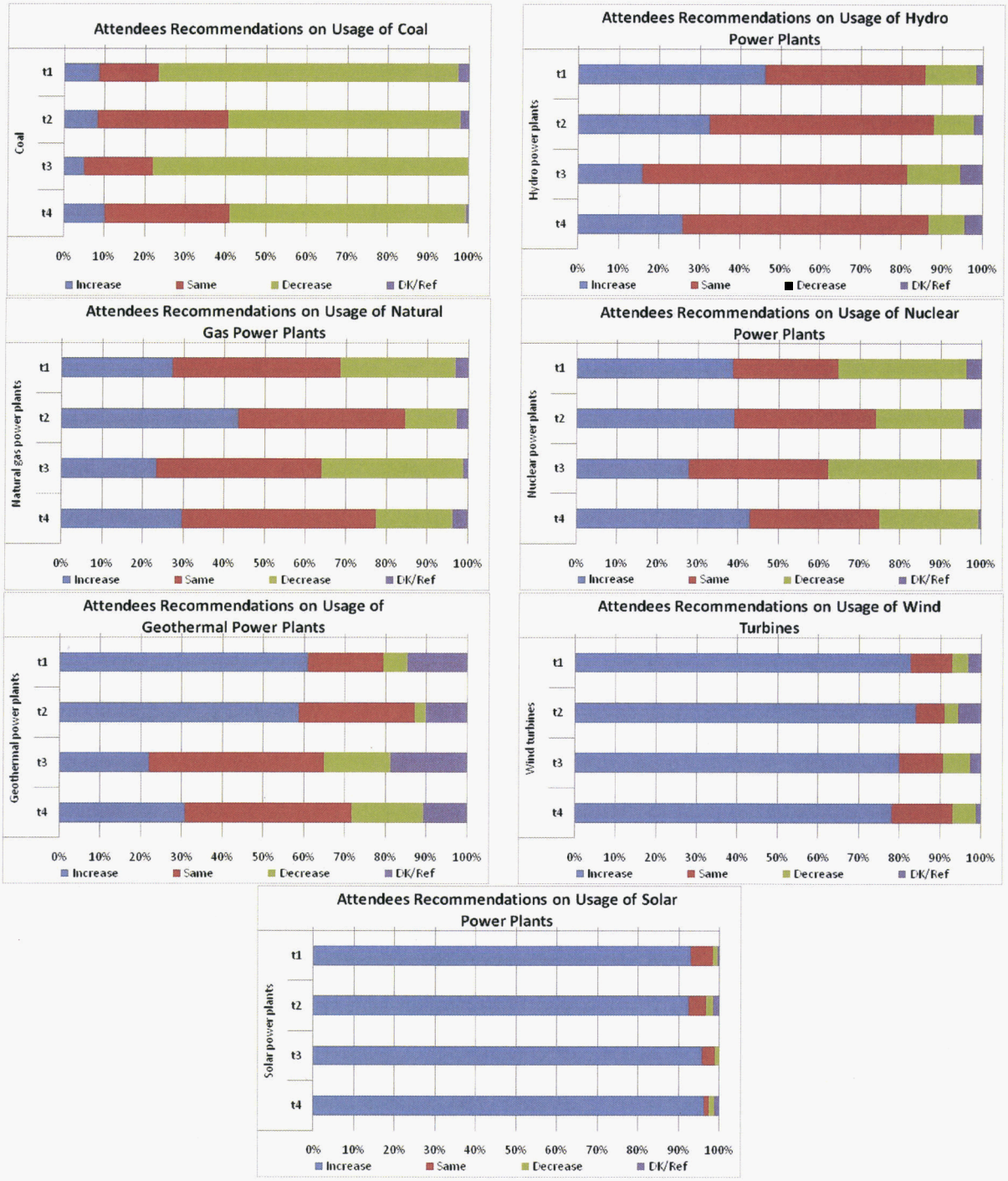

Attendees Recommendations on Usage of Coal
Coal
t1
t2
t3
t4
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Increase
Same
Decrease
DK/Ref
Attendees Recommendations on Usage of Hydro Power Plants
Hydro power plants
Attendees Recommendations on Usage of Natural Gas Power Plants
Natural gas power plants
Attendees Recommendations on Usage of Nuclear Power Plants
Nuclear power plants
Attendees Recommendations on Usage of Geothermal Power Plants
Geothermal power plants
Attendees Recommendations on Usage of Wind Turbines
Wind turbines
Attendees Recommendations on Usage of Solar Power Plants
Solar power plants

Figure 2.

Mixed Views on Nuclear Energy

Participants viewed nuclear energy as a dependable source of energy, yet it is also perceived as one of the highest-cost sources and as the second most harmful to the environment of the eight sources tested. (NOTE: These data were gathered prior to the Japanese nuclear crisis following the March 11 earthquake and tsunami. We do not know if that event would alter opinions about nuclear power.)

Dependability of Traditional Sources

While participants responded favorably to the development of renewable sources, they perceive dependability limitations for solar and wind power that are not shared by traditional energy sources, such as coal, natural gas and nuclear.

Lack of Awareness of Energy Efficiency

Most participants were familiar with individual energy conservation effects (e.g. conservative use of the thermostat in the summer and winter months), but few were familiar with the demand-side management of energy efficiency. Upon learning about this approach, many participants recommended more consumer education in this area.

Education Informed Attitudes for Those with No Knowledge of Energy

The number of "I don't know" responses to energy questions decreased during the study period. Given no apparent baseline knowledge of a topic area, or any existing opinion or attitude, the education process facilitated knowledge and attitude development for these participants. Some of the participants with baseline levels of knowledge or pre-formed attitudes and opinions surrounding energy changed some of their opinions during the educational process. However, after being away from this educational process for 30 days or more, many participants' attitudes and opinions "snapped back" to their pre-energy education positions. This suggests that while the education process can shift attitudes and opinions, permanent change may require a more sustained educational effort.

Perceptions of Energy Sources

The following graphics illustrate how each source performed on the dependability, harmfulness and expensiveness measurements over the four surveys administered. As noted above, participants with no opinion or attitude toward an issue measured on T1 were likely to form one by the conclusion of the study (T4).

Least Harmful, Least Expensive and Most Dependable Rating By Energy Source Across Surveys

Figure 3.

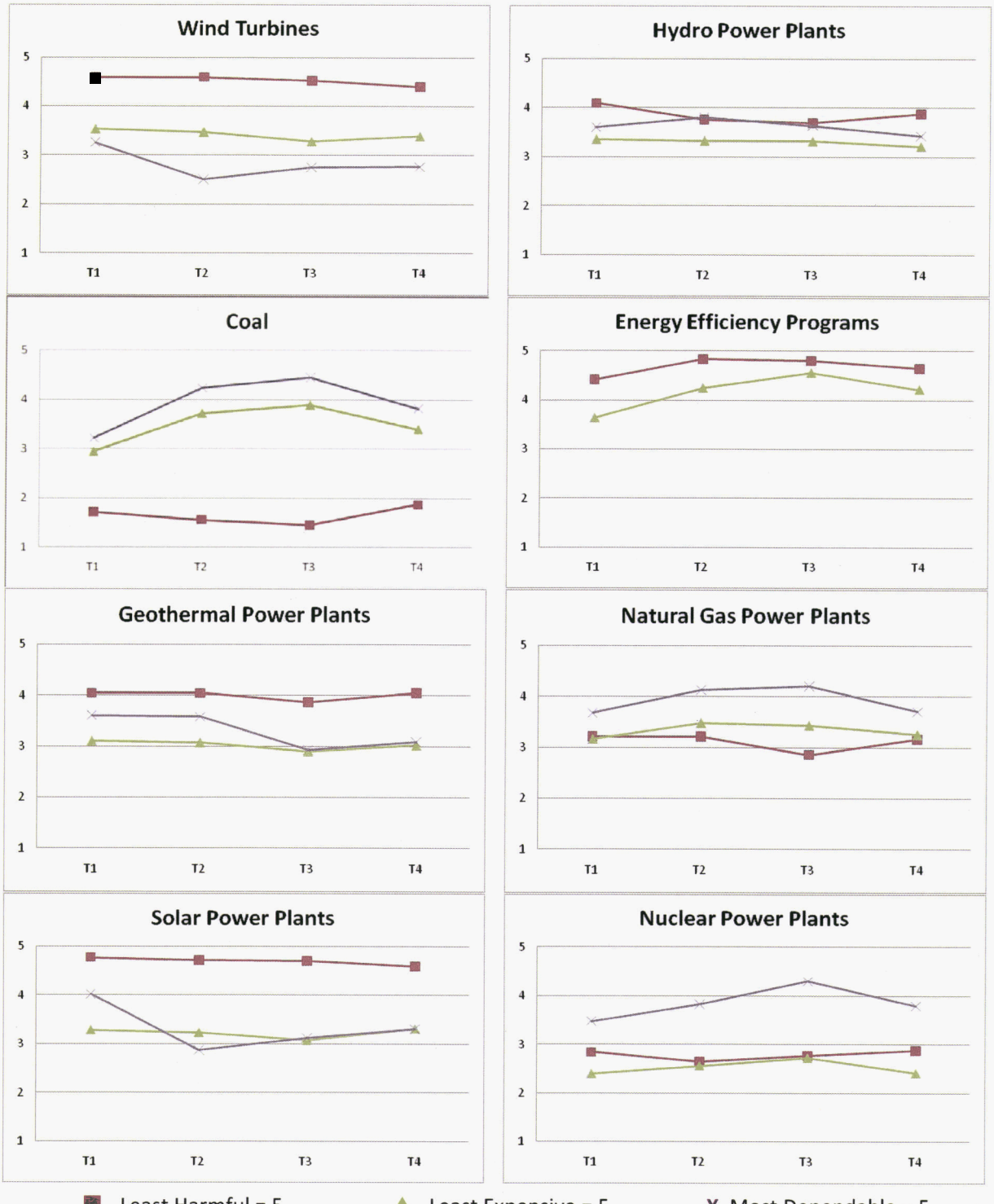


TABLE OF CONTENTS

PROJECT DESCRIPTION

Morrison Institute for Public Policy, a nonpartisan and independent center of research, analysis and public outreach at Arizona State University, conducted an Informed Perception project for Arizona Public Service (APS) to measure the attitudes and opinions of residential utility customers (hereafter referred to a "participants) toward energy-related topics, energy planning and their preferences about Arizona's energy future.

Specifically, the project addressed the following questions:

- What are the energy preferences and priorities of APS customers among the many resource choices?
- What factors influence these preferences and priorities?
- How does energy education affect attitudes and opinions about energy and energy planning?
- Do changes in opinions and attitudes persist over time, or do they revert to their previous position?

To answer these questions, data were gathered from residential utility customers in a variety of ways. First, a representative sample of 1,070 customers was interviewed by telephone to assess:

- Their attitudes and opinions about energy and energy planning concerning the eight energy sources being investigated – coal, energy efficiency, geothermal, hydro, natural gas, nuclear, solar and wind.
- How they perceived the importance of a series of energy-related issues.
- Their concerns about energy and energy development.

The survey administered for this first interview (T1)[3] was created and designed by Morrison Institute with the assistance of a 24-member Collaborative Committee and the Behavioral Research Center of Phoenix, which was responsible for conducting the interviews and administering the surveys.

The Collaborative Committee advised the project from start to finish. The Committee was comprised of representatives from various "points of view" in the energy industry, including the Sierra Club, the coal industry, the Inter Tribal Council of Arizona, renewable energy advocates, utility executives, energy consultants, labor advocates, university professors and proponents of energy efficiency. The goal was to elicit valuable input from all points of view so the project would be balanced and not communicate any bias either for or against any energy-related issues.

[3] All four questionnaires are located in Appendix A.

Collaborative Committee members included:

Sandy Barr, Sierra Club, Grand Canyon Chapter
Rich Bowen, Northern Arizona University
Leonard Chee, Navajo Nation
Elaina Curley, Inter Tribal Council of Arizona
Patrick Dinkel, Arizona Public Service (APS)
Rebekah Friend, Arizona AFL-CIO
David Getts, Southwestern Power Group
Herb Guenther, Arizona Department of Water Resources
Jeff Guldner, APS
Bill Harris, Science Foundation Arizona
Jason Hayes, American Coal Council
Kevin Higgins, Energy Strategies, LLC
Jodi Jerich, Residential Utility Consumer Office
John Lewis, Inter Tribal Council of Arizona
Karen Nicodemus, KA Nicodemus Consulting
Amanda Ormond, The Ormond Group
Elliot Pollack, Elliot D. Pollack & Company
Jeff Schlegel, Southwest Energy Efficiency Project
Ken Strobeck, League of Arizona Cities and Towns
Elaine Wilson, Inter Tribal Council of Arizona
Nicole Woodman, City of Flagstaff
Corey Woods, Phoenix Union High School District
Ellen Zuckerman, Southwest Energy Efficiency Project
Cynthia Zwick, Arizona Community Action Association

The 1,070 interviews were completed in two waves. First, a representative sample of 800 Arizona Public Service (APS) customers was interviewed and used as a representative comparison base for the second sample. The second sample of 270 was interviewed with the same questionnaire used with the first sample (the Time 1 or T1 questionnaire).

Upon interview completion, participants from the second sample of 270 were recruited to be part of the study population and to attend a one-day Energy Forum held in Scottsdale, Arizona, on December 4, 2010. Following the interview with and recruitment of these 270 participants, a 24-page Energy Briefing Book was mailed to them. This book offered a description of Arizona's energy issues and provided a primer on energy and energy planning, including descriptions of the strengths and weaknesses of each of the eight energy sources being investigated. The book was created and designed by Morrison Institute in conjunction with the Collaborative Committee.

On December 4, 2010, 184 of the 270 APS customers recruited to attend the Energy Forum arrived for the one-day event at the Scottsdale Resort & Conference Center.[4] Upon their arrival,

[4] 86 recruited attendees were no shows; however, the expected sample size was between 180 and 200. The actual number of 184 attendees fell within the targeted range.

participants completed a second survey (T2), which included most – but not all – of the questions from T1. The goal was to determine whether exposure to the briefing booklet resulted in any changes in attitudes and opinions toward the energy-related issues being measured in the surveys.

After completing the survey, there were two panel presentations/discussions – one at the start of the day and a second following the lunch break. The six panelists were respected energy experts from utilities, traditional energy sources/fossil fuels and renewable energy. Panelists discussed energy and energy planning for 30 minutes and answered questions from participants for an additional 15 minutes.

Panelists were:

Pat Dinkel, Vice President, Power Marketing and Resource Planning, APS

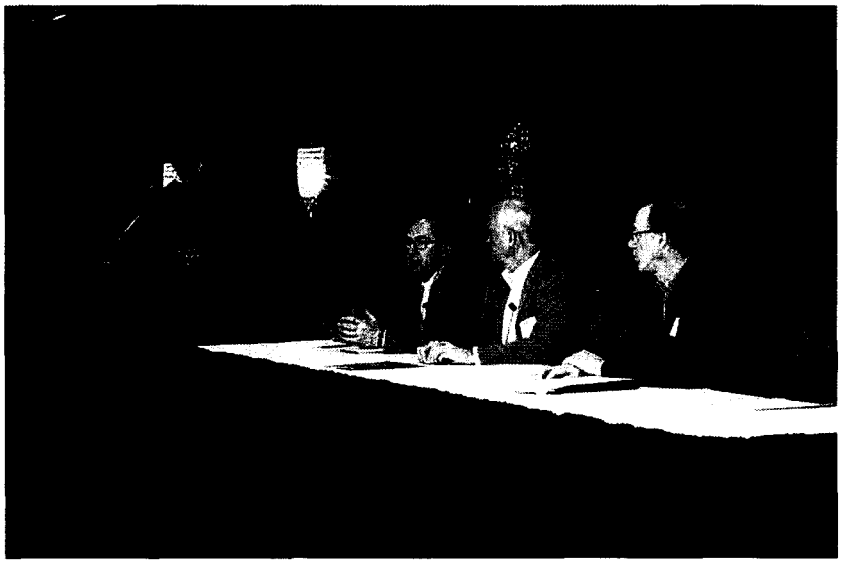
Gary W. Dirks, Ph.D., President Asia Pacific British Petroleum, China (Retired), Director Arizona State University LightWorks

George Gross, Ph.D., Professor, Institute of Government and Public Affairs, University of Illinois

Tim James, Ph.D., Director of Research and Consulting, L. William Seidman Research Institute, Research Professor, W.P. Carey School of Business, Arizona State University

David Olsen, Managing Director, Western Grid Group

Amanda Ormond, The Ormond Group



Participants took part in three separate 1½-hour small group discussions comprised of 12 to 15 participants, led by a professional small group moderator with no APS presence or outside influence. These small group discussions addressed critical energy issues that included tradeoffs[5] and detailed conversations about the strengths and weakness of each of the eight energy sources tested. During the small group discussions, moderators were in electronic contact with energy experts who could field questions from participants that the moderator was unable to answer. Answers were texted back to the moderator who would then communicate them to the participants.

Following the third group discussion, the 184 participants reconvened in the main conference room and were given a final opportunity to ask questions about energy and energy planning before again completing the survey (T3) containing the questions that were included in T1 and T2. T3 was administered to determine whether the daylong Energy Forum had in any way altered participants' attitudes and opinions about energy and energy planning.

Finally, 30 days following the Energy Forum, participants were contacted by telephone and asked to complete the survey a final time (T4) to determine whether time away from energy information and education had any effect on attitudes and opinions.

The following sections of this report provide greater detail on the overall project, the Energy Forum event, and results from the 4-time-point survey. Specifically, the report will cover energy considerations that are important to the participants; preferences about the usage of each energy source; beliefs about the harmfulness, expense and dependability of each source; customer cost-tolerance; and attitudes and concerns about individual sources. The appendices provide methodology and results detail, including surveys used (T1-T4), information on participant demographics and methods, and technical data.

[5] Paradoxical questions included "How do you reconcile the fact that a low-cost energy source pollutes the atmosphere more than a higher cost energy source?"

WHAT ARE UTITLITY CUSTOMERS WILLING TO PAY?

A survey (T1) was conducted with the exogenous sample of 800, which did not include attendee respondents.[6] This survey asked respondents whether they would be willing to pay a particular dollar amount, monthly, to address a specific energy issue[7] including:

- Assuring a significantly cleaner environment for Arizona
- Assuring an uninterrupted supply of electricity to Arizona
- Creating jobs in the energy industry for Arizona
- Helping to develop new renewable energy technologies

The organization of the question followed two parts. (See Appendix C for process flow chart.) First, respondents were asked about the size of their monthly electric bill. Based on the categorical answer to this question, three price points were generated representing a 20%, 10%, and 5% increase on their bill. For example, if a participant's bill was $100 per month, he or she was asked about his or her willingness to pay an additional $20 per month (the 20% test), an additional $10 (the 10% test) or an additional $5 (the 5% test) to achieve one of the end results listed above. Once they said "yes" to an increased level – they were asked in descending order – they were not asked the lower amounts.

The goal of this process was to determine the agreeable price point to address each issue area tested.[8] The data were analyzed in five ways:

1. The mean dollar amounts that respondents were willing to pay were calculated for each issue.
2. Simple frequency tables showcasing the responses to each issue area were created.
3. An ordinal logistic regression[9] was performed to estimate the effects of important control variables on the likelihood that respondents would increase their percentage point threshold.
4. Each response was coded in percent units and reported the adjusted average percentage that respondents would be willing to pay.
5. The dependent variable was coded into the dollar amount posed to the respondents and another simple regression was run to predict the adjusted average dollar amount.

---

[6] Because of the limited responses per topic, and because of the bias in attendee sample, this analysis focuses only on the exogenous sample and does not include attendee respondents.

[7] This sample was divided into four and asked willingness to pay on one of the four issue areas.

[8] The dependent variables in this analysis are the agreeable price points for each issue with 20% (coded 3), 10% (coded 2), 5% (coded 1), or none at all (coded 0).

[9] This analysis gives us an impression as to which factors influenced their answers.

Following are the results of these analyses:

1. Mean Dollar Amounts

A mean was calculated across the entire population. Typically, respondents were willing to pay, approximately, an additional $6 per month across all four energy issues. For example, for "a cleaner environment," respondents were willing to pay the most, an average of an additional $7.38 per month (see Table 1). However, when the distribution of the data was examined it was clear that a skewed distribution caused these averages to be higher than what a typical customer is willing to pay.

Mean Dollar Amounts Respondents Are Willing to Pay by Program

	Mean dollar amount answer
Assuring a significantly cleaner environment for Arizona	7.23 (N=131)
Assuring an uninterrupted supply of electricity of Arizona	5.69 (N=127)
Creating jobs in the energy industry for Arizona	6.59 (N=135)
Helping to develop new renewable energy technologies	6.31 (N=160)

Table 1.

2. Frequency Tables of Percentage Thresholds Related to Issue Areas

Findings revealed that the majority of respondents were willing to pay at least something additional. There was variance, however, as to how much. As demonstrated in Figure 4, this resulted in a bi-modal distribution where most of the responses were located at the extremes – a willingness to pay nothing or to pay an additional 20% – regardless of the issue being addressed. The minority fell into the middle categories, willing to pay an additional 5% or 10%.[10]

[10] See Appendix D for data detail.

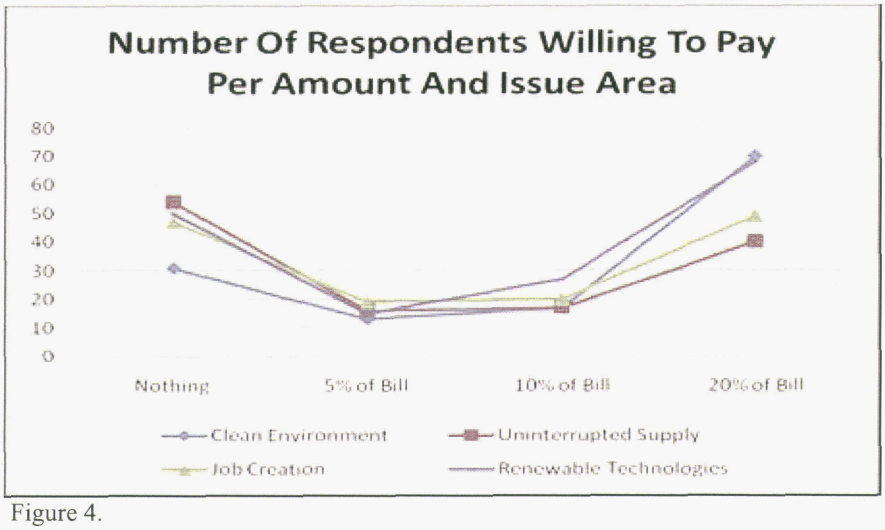


Figure 4.

To illustrate these findings a different way, the following pie charts (Figures 5-8) show the percentage of respondents willing to pay an additional amount to address each of the specific issues. The blue and purple areas (no increase and 20%, respectively) are the most dominant for each issue area, again demonstrating the disparity between the lowest and highest amount that people are willing to pay. For example, on the issue of a cleaner environment (Figure 5), 75% of the respondents either answered they would pay nothing (24%) or pay 20% more on their electricity bill (53%).

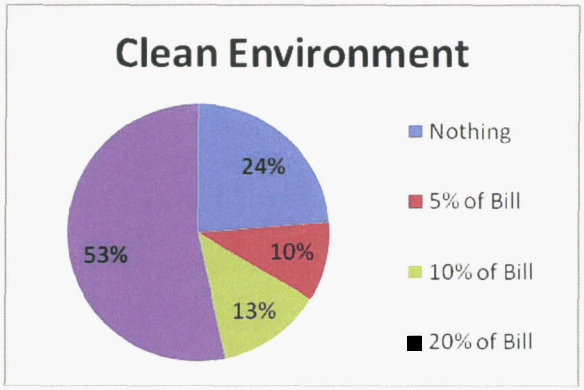


Figure 5.

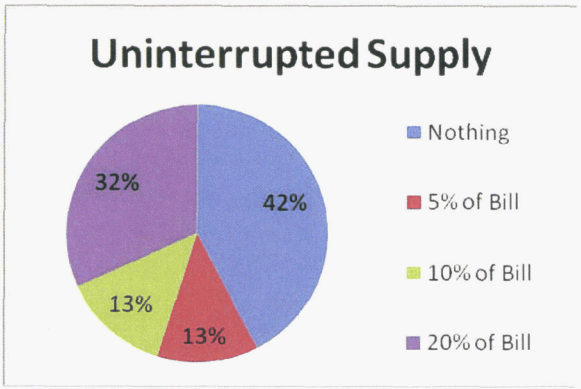


Figure 6.

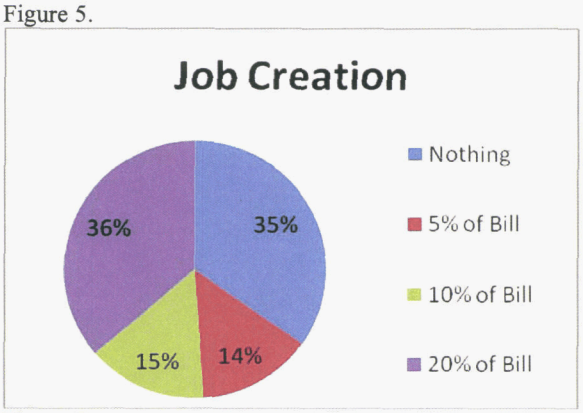


Figure 7.

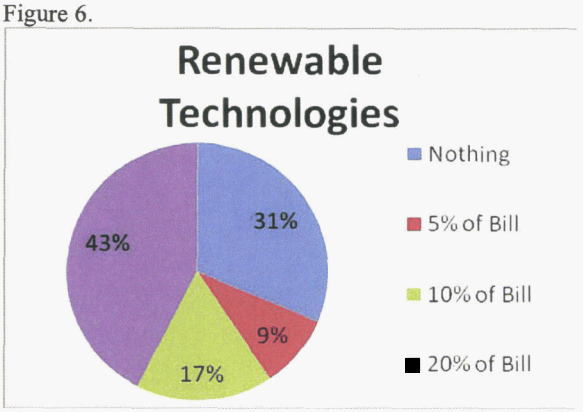


Figure 8.

"Assuring a clean environment" was the only issue that garnered a majority willing to pay 20% more. The other three issues fell into the bi-modal distribution of all (20% more on their bill) or nothing. For example, Figure 6 shows that 42% of respondents would not be willing to pay any additional amount for "an uninterrupted supply of electricity," while 31% were willing to pay the additional 20%. Further, Figure 7 shows that 35% of respondents who were asked if they would pay a higher bill to "assure job creation" were unwilling to pay additional money for that outcome, while 36% were willing to pay 20% more on their monthly bill to assure more jobs. And, in Figure 8, related to "the development of renewable energy technologies," more than 43% of consumers were willing to pay an additional 20%.

3. Predictors of Willingness to Pay

An ordered logistic model was run to predict price thresholds for the four issue areas (see Appendix E). Interestingly, for the issue of "keeping the environment clean," findings revealed that income had absolutely no impact on participants' willingness to pay an additional fee on their electrical bill, while there was a negative impact based on the size of the participants' monthly bill. That is, for every $100 increase in the monthly bill, individuals were 38% *less*

likely to be willing to absorb an even larger increase to their bill. In short, the larger the participants' electrical bills, the less willing they were to absorb a real dollar amount increase.

Predictably, those who were less concerned with keeping rates low were more than twice as likely to be willing to increase their percentage contribution. However, when we considered the reference person, almost three-quarters of them were estimated to be willing to pay at least some percent increase on their energy bill.

A similar set of results emerged for assuring "an uninterrupted supply of electricity." As the monthly bill increased, the likelihood of a willingness to pay a higher rate decreased. Predictably, those less concerned with keeping rates low were more willing absorb a rate increase.

Unlike the previous two issues – "a clean environment" and "an uninterrupted supply of energy" – the monthly bill did not have a statistically significant effect on "job creation." However, the importance of keeping rates low was still a strong negative predictor. With renewable energy, the monthly bill amount was an important predictor, but wanting to keep rates low did not have an effect.

While the majority of participants are willing to pay at least a minimal additional amount on their monthly bill for each of the four issues tested, the percentage increase they are willing to absorb *decreases* as their monthly bill *increases* – in short, there is a preference for a set amount as a monthly increase, not a percentage of their current bill. This suggests that individuals are willing to pay a defined dollar amount that does not increase as their bill or rate increases. Also, those who believe that their bottom line is important to them will be less likely to support such measures. Auxiliary analysis suggests that for every $100 increase in the monthly bill, respondents are 72% more likely to worry about keeping energy rates low. It is important to note that income did not play a role in their answers.[11]

4. Adjusted Average Dollar Amount Respondent Willing to Pay

Since the negative effects of monthly bills on the additional percentages to their bills consumers were willing to pay were so pronounced, and because of the skewed distribution of the data, an additional analysis was performed. Here, the log of the dollar amount that people found acceptable was the dependent variable for a simple linear regression[12], which allowed us to see the effect of each factor on actual dollar and also allowed for adjusted averages as demonstrated in Figure 9 (the exponent of the intercepts minus 1). The data from these tables are located in Appendix F.

[11] This may not be an artifact of correlation, income and the monthly bill were only correlated at .3

[12] Specifically, we logged the dollar amount plus $1 because you cannot log a value of 0

In contrast to the means report earlier, people are willing to pay only an additional $3 or $4 per month for these programs.

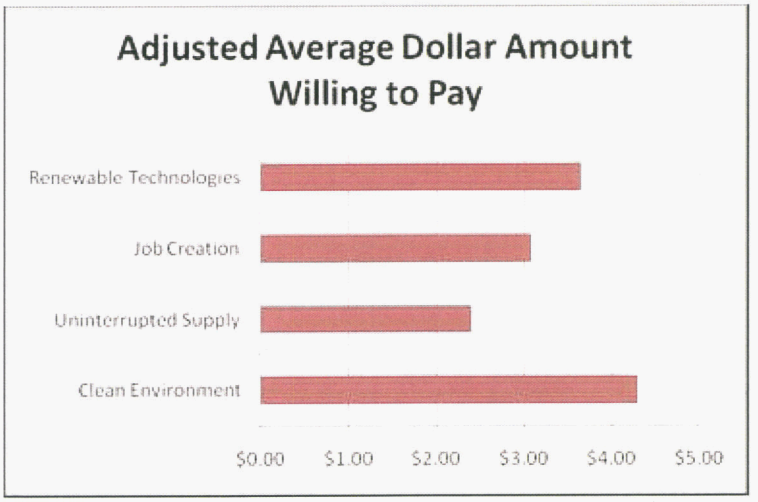


Figure 9.

WHAT IS IMPORTANT TO UTILITY CUSTOMERS?

On each of the surveys (T1-T4), participants were asked to indicate the importance – to their individual selves – of 10 energy-related items on a 5-point Likert scale, with 1 representing "not at all important" and 5 as "extremely important."[13]

The following 10 items are listed in order of importance[14] and are presented in Figure 10, based on the final interview (T4). Figure 10 shows the percentage of participants who rate each item as extremely important – a 5 on the 5-point scale.

1. Getting electricity from resources that will never be used up
2. Avoiding electricity outages on hot summer days
3. Reducing radioactive wastes
4. Minimizing air pollution
5. Keeping electricity rates low
6. Reducing emission of gases
7. Creating jobs in Arizona
8. Using power produced in Arizona
9. Generating your own electrical power
10. Avoiding facilities that detract from scenic beauty

[13] Survey questions and results on individual items located in Appendix A.
[14] At T4, based on an average of response scores.

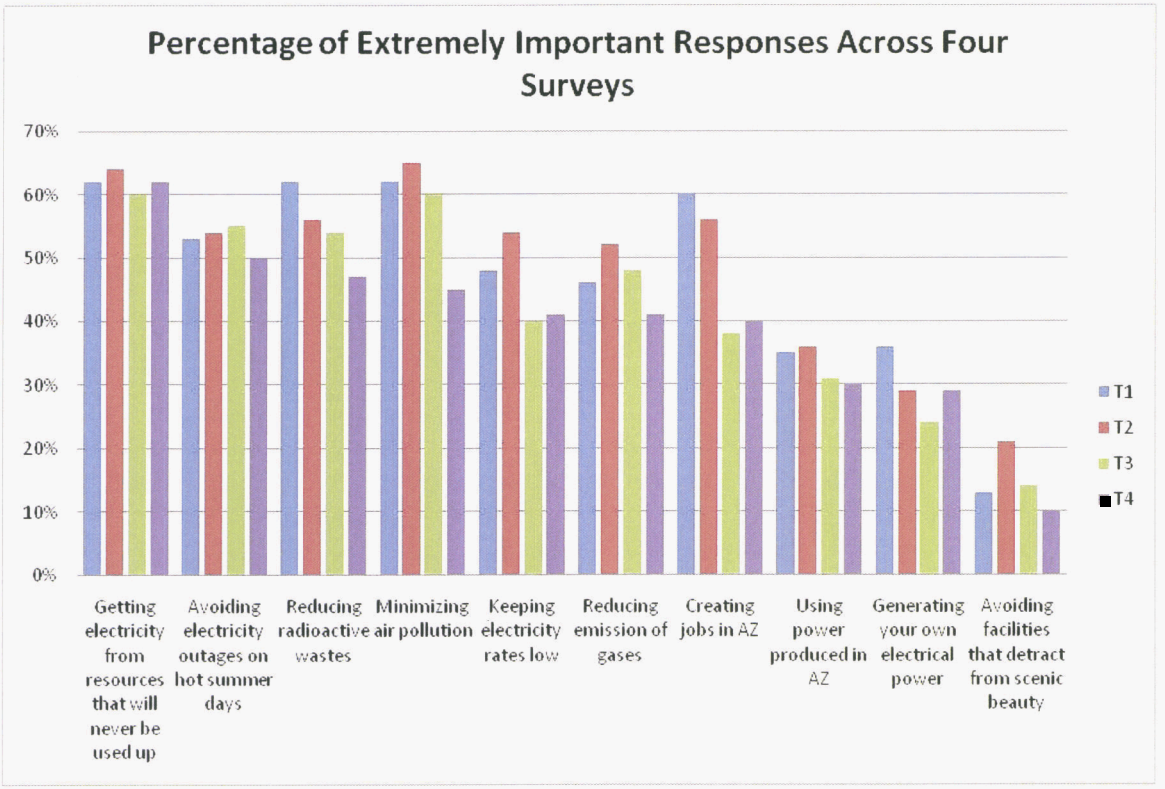


Figure 10.

Regardless of which measure is used – "extremely important" (5 on the 5-point scale) or a combination of "extremely" (5) and "somewhat important" (4) – and regardless of which of the four questionnaires is considered, three of the tested items emerge as most important to participants, with a fourth not far behind.

The highest ranking item, "getting electricity from sources that will never be used up," tops the 10 items across all questionnaires. It is also ranked highest when just considering those who ranked it as "extremely important" and highest when combining "extremely" and "somewhat important."

At the time of the initial survey (T1), before participants had seen the Energy Briefing Book and before attending the Energy Forum, 65% ranked "getting electricity from sources that will never be used up" as "extremely important" and 81% ranked it as either "extremely" or "somewhat important." By the end of the study, four weeks following the Energy Forum, 60% ranked it as "extremely important" and 84% ranked it as "extremely" or "somewhat important." In short, participants are attuned to renewable energy sources and strongly support their development.

Two items rank closely behind "getting electricity from sources that will never be used up" – "minimizing air pollution" (63% "extremely important," 81% "extremely" or "somewhat important" in T1, 45% and 80%, respectively, in T4) and "avoiding outages on hot days" (53%

and 75% in T1; 49% and 80% in T4). Both these items shifted somewhat from where they started to where they ended, but both consistently rank high compared with the other tested items.

Between 80% and 85% of participants rank "minimizing air pollution" as "extremely" or "somewhat important" across the four questionnaires, an importance ranking equal to that of "getting electricity from sources that will never be used up." And on the "extremely important" measure it ranks second highest, just behind "getting electricity from sources that will never be used up," at 63%. By the end of the study, however, only 45% of participants rank "minimizing air pollution as "extremely important" to them. Even so, it still ranks as fourth-most important on the "extremely important" scale for T4.

While more than 8 in 10 participants consider "avoiding electricity outages on hot summer days" as "extremely" or "somewhat important," as they gained greater insight into energy and energy planning through exposure to the Energy Briefing Book and day-long attendance at the Energy Forum, the importance of this item increased significantly, from 75% ranking it "extremely" or "somewhat important" in T1, to 83% in T2 and to 88% in T3. But, a month following the event, participant assessment of the importance of this item dropped to 80%. Even so, it remains, along with "minimizing air pollution," the second-most important item among those tested – only a few percentage points behind "getting electricity from resources that will never be used up."

"Reducing radioactive wastes" ranks fourth among the 10 items, with 71% considering it to be "extremely" or "somewhat important" at the end of the study (T4). And, it remains consistently in the 70% range across all four surveys. When just considering those who ranked it as "extremely important," "reducing radioactive wastes" ranked third-most important on both T1 (60%) and T4 (40%). Neither the Energy Briefing Book nor the Energy Forum had any measurable effect on this item.

Two other items were ranked as "extremely" or "somewhat important" by nearly two-thirds (64%) of participants by the end of the study (T4), although both dropped in importance compared with where they started (T1). The first, "reducing the emission of gases that may contribute to global warming," clearly has environmental implications while the second, "creating jobs in Arizona," is strictly economic. "The importance of reducing emissions" rose in importance after participant exposure to the Energy Briefing Book and, again, immediately following the Energy Forum, but dropped significantly a month following the event – the time of the fourth and final interview (T4). During the T1 interview, 48% of participants ranked "reducing the emission of gases that may contribute to global warming" as "extremely important." By the time of the T1 interview, that percentage had dropped to 41%.

However, the importance of "creating jobs in Arizona" dropped precipitously as participants were exposed to the Energy Briefing Book and attended the Energy Forum. Prior to any exposure (T1), 82% ranked "creating jobs in Arizona" as "extremely" or "somewhat important." Following exposure to the booklet (T2) such sentiment dropped to 74% and immediately following the Energy Forum (T3) it dropped again, to 68%. A month after the event (T4) it dropped to 64%. When just considering those who ranked it as "extremely important," "creating jobs in Arizona" dropped from 60% in the T1 interview to 40% in T4.

By the time the fourth interview (T4) was conducted, one month following the Energy Forum, nearly six in 10 participants (59%) ranked "keeping electricity rates low for consumers" as "extremely" or "somewhat important" to them (42% ranked it as "extremely important"). However, that is a significant drop from the 80% who ranked it as "extremely" or "somewhat important" just prior to the Energy Forum (T2). Prior to exposure to the booklet (T1), only 66% ranked keeping rates low as "extremely" or "somewhat important."

"Using power produced in Arizona" is the ninth-most important item of the 10 tested. In fact, 53% of participants consider it to be "extremely" or "somewhat important" to them. There was no significant change in opinions about this item across any of the four surveys; however, participants at the Energy Forum noted that Arizona must also focus on innovation and ingenuity, and that as a state and citizenry we need to think our way to better solutions.

The 10th -ranked item, "avoiding facilities that detract from the scenic beauty of Arizona," ranked far behind the other nine in importance. By the time the final survey was conducted, only 21% considered this item as "extremely" or "somewhat important" to them, and only 10% consider it "extremely important."

Figure 11 presents survey respondents' views on the importance (4 or 5 on the 5-point scale) of the 10 energy-related items measured. More than half of the participants felt that nine of the 10 items[15] were at least "somewhat important to them."

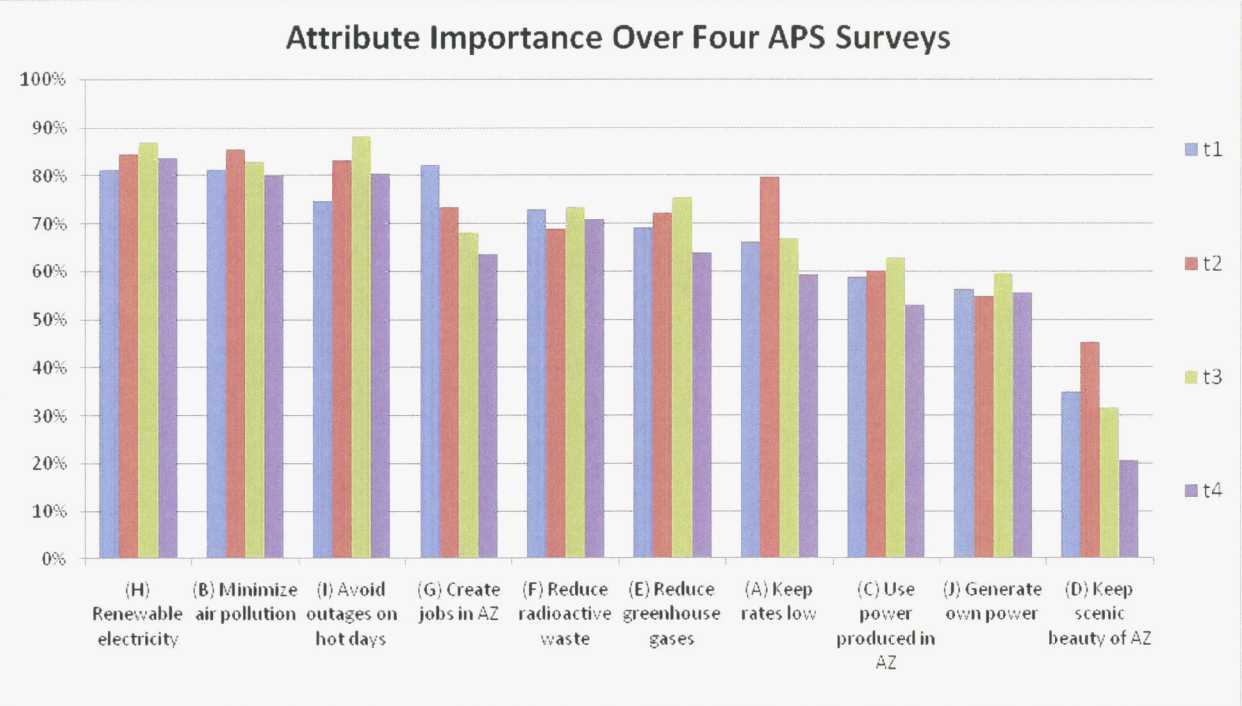


Figure 11.

[15] One item was the exception: "avoiding facilities that detract from the scenic beauty of Arizona."

As Figure 11 indicates, exposure to the two treatments, the Energy Briefing Book and the Energy Forum altered opinions temporarily (if not greatly) for most, but not all, items. But once participants returned home and were away from the "energy talk" for a month, most opinions returned to or near their pre-treatment levels.[16]

What energy-related issues are of most concern to consumers?

Figure 12 shows the percentage of respondents at T1, T3 and T4 that ranked each issue a 4 or a 5 on a 5-point scale, with 5 being "extremely concerned." Of the nine issues tested, four lead the way (at the end of the study (T4)) with more than 60% of participants expressing concern (rating them a 4 or 5 on a 5-point scale where 5 is extremely concerned). Of greatest concern to participants are "air pollution produced by burning fuel to make electricity" (66%), "radioactive waste from nuclear power plants" (65%), "the security of our power grid from terrorist attacks" (65%) and "greenhouse gases produced by burning fuel" (60%).

These four "concerns" also lead the way when taking just the highest concern level (5 on the 5-point scale) into consideration. "Radioactive waste from nuclear power plants" is the most widespread concern when just considering the percentage who ranked each item a 5, with 46% of participants rating their concern a 5, followed by "security of our power from terrorist attacks" (38%); "greenhouse gases produced by burning fuel" (34%); and "air pollution produced by burning fuel to make electricity" (34%).

Three others – "global warming" (47% when taking a rating of 4 or 5 into consideration, with 28% rating it a 5), "damage to river habitats from hydroelectric dams" (43%, 17%) and "loss of water resources from hydro electric dams, solar thermal facilities or other generating facilities" (41%, 21%) – concern more than four in 10 participants.

The remaining two – "the cost of building renewable power plants" and "the visual impact of wind farms or high voltage transmission lines on the scenery of Arizona" – are low on the list of concerns, 32% and 14%, respectively. When looking at just those who rated them a 5, 13% and 9% indicated concern.

With only one exception, all concerns rose immediately following the Energy Forum (T3) but dropped back to pre-treatment levels or below one month following the event (T4). It appears, at least for this set of items, it is possible to raise concerns in the short term but, once separated from energy information and education, levels of concern drop to pre-treatment levels.

[16] There were two exceptions. One was the drop in importance for "avoiding facilities that detract from the scenic beauty of Arizona," which was perceived by participants as less important by T4 (T1 was 35% and T4 was 21%); and "creating jobs in Arizona," which was also perceived as less important by the end of the process than at the beginning (T1 was 82% and T4 was 64%).

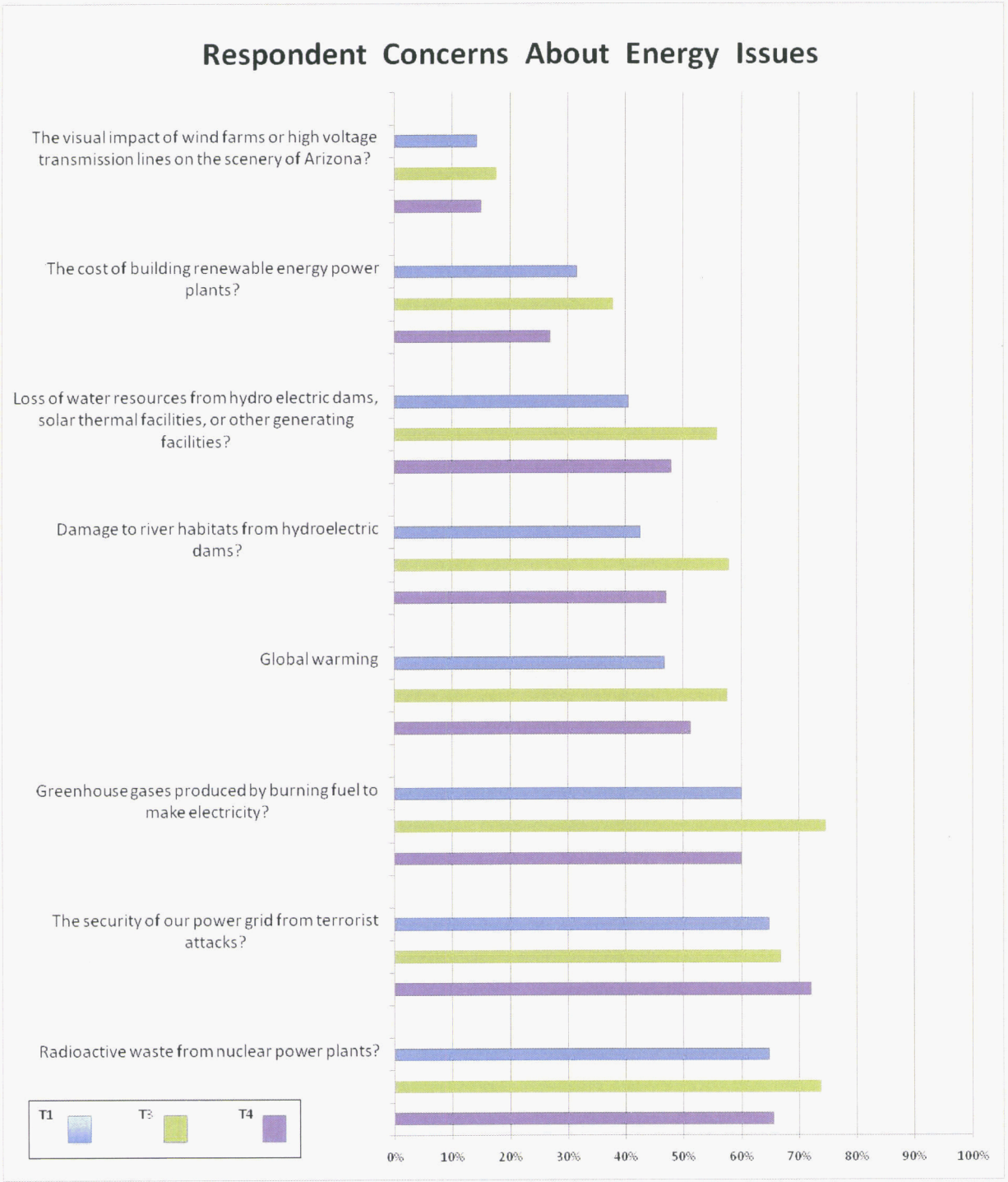

Respondent Concerns About Energy Issues
The visual impact of wind farms or high voltage transmission lines on the scenery of Arizona?
The cost of building renewable energy power plants?
Loss of water resources from hydro electric dams, solar thermal facilities, or other generating facilities?
Damage to river habitats from hydroelectric dams?
Global warming
Greenhouse gases produced by burning fuel to make electricity?
The security of our power grid from terrorist attacks?
Radioactive waste from nuclear power plants?
T1
T3
T4
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

Figure 12.

SOURCE USAGE

For the eight sources of energy addressed in this project – coal, energy efficiency, geothermal, hydroelectric, natural gas, nuclear, solar, and wind – participants were asked in each of the four polls to assess whether Arizona should increase, decrease or maintain its dependence on seven of the eight, excepting energy efficiency.[17] Further, participants were asked to assess the harmfulness to the environment, expense and dependability of each of the eight energy sources.

Perceived Usage of Energy Sources

Figure 13 details participants' opinions about usage levels of each source at four points in time, T1 – T4, with T1 administered before the treatment of the Energy Briefing Book and Energy Forum, T2 after receiving the Energy Briefing Book, T3 immediately following the Energy Forum, and T4 one month later. Participants were asked whether use of each source should be increased, decreased or kept at its current level in the future.

On usage preferences the findings are clear: Across all four surveys, participants overwhelmingly favored increased use of renewable energy sources – solar and wind. In fact, one participant asked in the small group discussion, "What is the timeframe for implementing renewable projects?" This finding is consistent with the participants' companion concern for environmental sensitivity.

Equally striking was the participants' consistent call, across all four surveys, for a reduced dependence on coal as an energy source. For each of the other four energy sources – geothermal, nuclear, hydroelectric, and natural gas – participant responses varied from survey to survey as to their level of future usage. T1 and T2 showed that participants favored an increased use of geothermal. But, following the Energy Forum, when T3 was conducted, the consensus was to maintain geothermal usage at its current level and, by the time T4 was administered, only a modest increase in geothermal was recommended.

In fact, immediately following the Energy Forum (T3) the consensus was that coal usage should be decreased, solar and wind increased, and all other sources maintained at their current levels. But by T4, 30 days following the Energy Forum, while participants continued to call for decreased coal usage and the vast majority called for an increase in the use of solar and wind as energy sources, more than half preferred modest increases in each of the other sources.

[17] Energy efficiency is a unique energy source that will be addressed in other sections of this report.

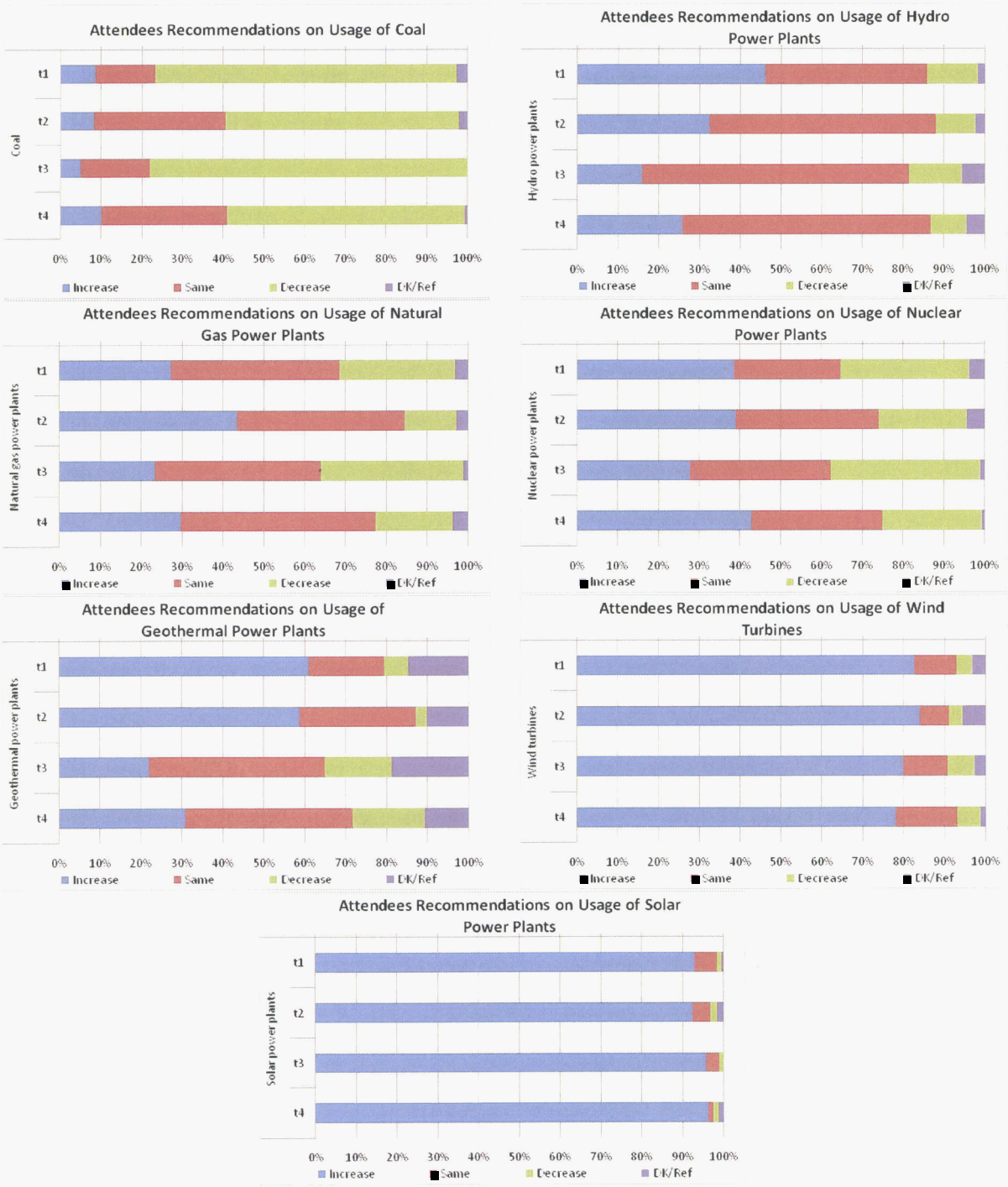

Attendees Recommendations on Usage of Coal
Coal
t1
t2
t3
t4
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Increase
Same
Decrease
DK/Ref
Attendees Recommendations on Usage of Hydro Power Plants
Hydro power plants
Attendees Recommendations on Usage of Natural Gas Power Plants
Natural gas power plants
Attendees Recommendations on Usage of Nuclear Power Plants
Nuclear power plants
Attendees Recommendations on Usage of Geothermal Power Plants
Geothermal power plants
Attendees Recommendations on Usage of Wind Turbines
Wind turbines
Attendees Recommendations on Usage of Solar Power Plants
Solar power plants

Figure 13.

Harmfulness to the Environment

Participants were also asked to assess the harmfulness to the environment, expense and dependability of each energy source during each survey administration. Figure 14 presents participant responses to the question of how harmful they perceive each energy source to be to the environment, with 1 representing most harmful and 5 the least harmful.[18]

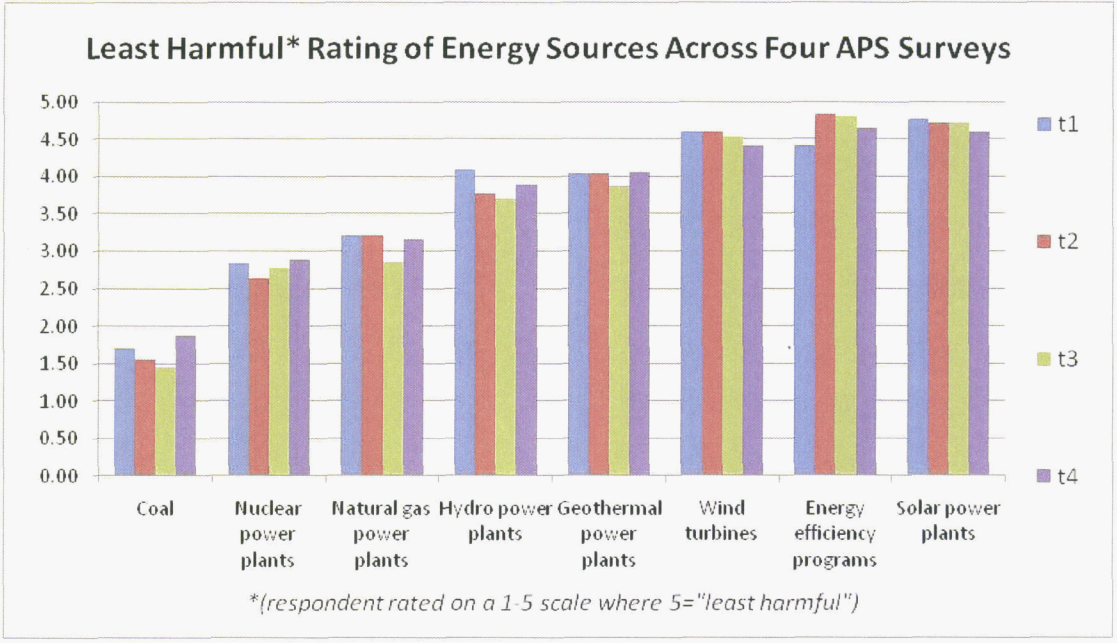


Figure 14.

Participants clearly view renewable energy sources as the least harmful to the environment among the sources tested. All renewable sources receive high scores – indicating least harmful – from participants across all four surveys. In fact, solar and energy efficiency were rated 4.6, on a 5-point scale, in the final survey, T4. Wind was close behind at 4.4. Geothermal and hydro also are viewed as environmentally friendly with 4.1 and 3.9 scores, respectively.

Coal, on the other hand, is viewed as most harmful among the sources tested, receiving a 1.9 rating in the fourth survey – better than the 1.7, 1.6 and 1.5 it received in T1, T2 and T3, respectively, but still a full point below nuclear, perceived as the second-most harmful energy source at 2.9.

Perceptions of harmfulness did not change greatly across the four surveys. Neither the Energy Briefing Book nor the Energy Forum content moved opinions significantly. Solar, energy efficiency and wind were viewed as least harmful in the first survey and remained so throughout the remaining three surveys. Coal started at the bottom and stayed there, although it was viewed

[18] The responses were reverse-coded from the original survey items for Harmfulness so that the most positive attributes would be equated with the highest number.

more positively by the fourth survey than it was in any of the three preceding surveys. But, it still remained solidly in last place.

Least Expensive

Figure 15 reports the responses of survey participants to the question of how expensive they perceive each energy source is to produce with 1 representing the most expensive and 5 as least expensive.[19]

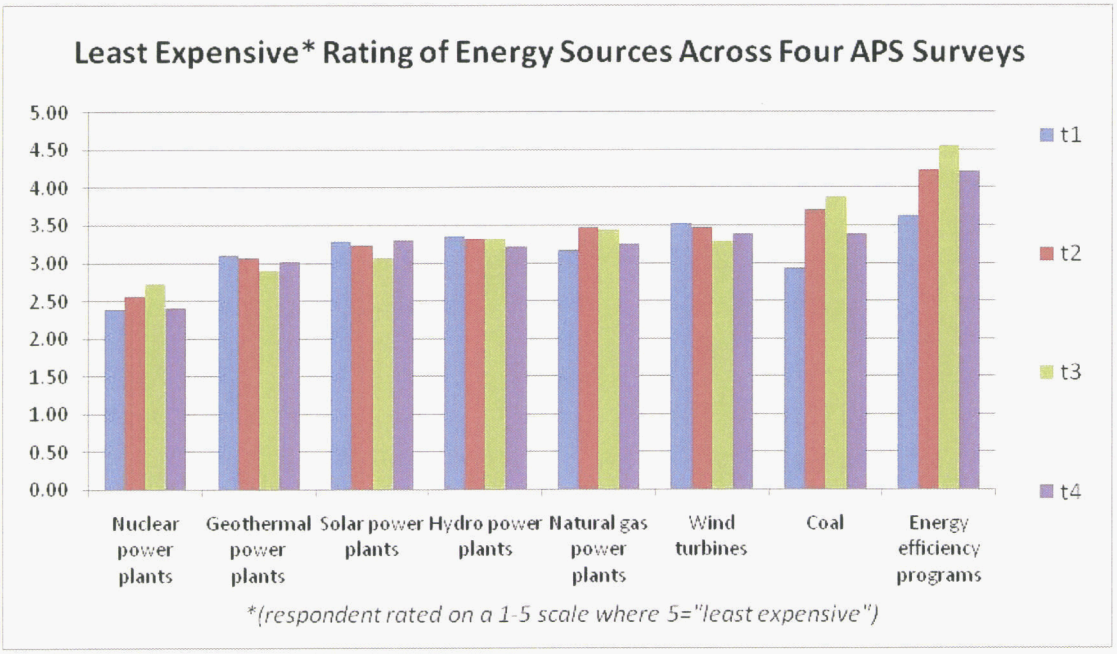


Figure 15.

Energy efficiency is perceived not only as the least-expensive energy source, it is viewed by participants as the least-harmful energy source, as well. The perception of the cost for energy efficiency changed between the first poll (T1), when participants hadn't received any educational material, and the second (T2), after they had received the Energy Briefing Book. The score for energy efficiency rose from 3.6 to 4.2, an indication that, after reading the Energy Briefing Book, participants viewed energy efficiency as a low-cost-to-produce energy source. Nuclear energy is at the other end of the scale – viewed as the most expensive to produce among the eight energy sources tested. While energy efficiency receives a 4.2 in the fourth survey (T4), viewed as least expensive, nuclear receives a 2.4, viewed as the most expensive. In fact, nuclear ended where it started in the first survey (T1), at 2.4.

The remaining energy sources received scores of between a 3.0 (geothermal) and 3.4 (coal and wind) in the fourth survey (T4). With the exception of participants' perceptions of the cost of producing energy from coal (they perceived coal as a less-expensive source by the end of the

[19] Responses were reverse-coded from the original survey items for Expensiveness so that the most positive attributes would be equated with the highest number.

study than they originally believed) the education process didn't affect opinions significantly. Coal was perceived to be more expensive in T1 (2.9) than in any of the subsequent surveys - T2 (3.7), T3 (3.9), T4 (3.4).

Dependability

Figure 16 reports on the responses of survey participants to the question of how dependable they perceive each energy source is for generating electricity, with 1 being the least dependable and 5 the most dependable.[20]

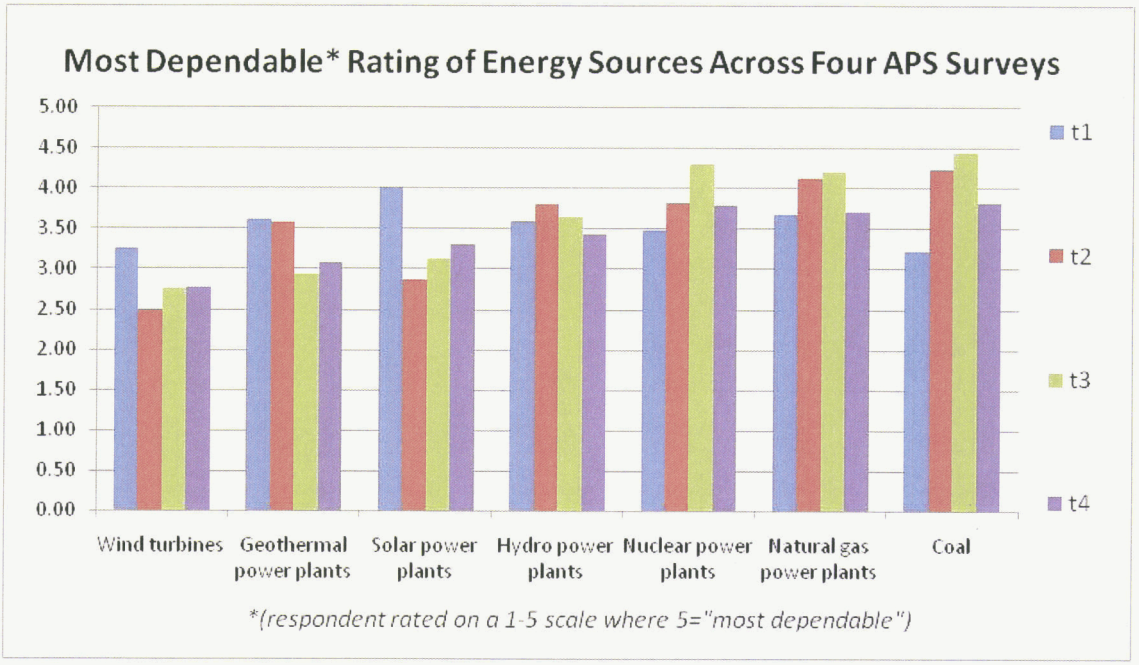


Figure 16.

While solar- and wind-generated power scored positively with participants for both cost and environmental friendliness, both ranked near the bottom for dependability – 3.3 and 2.8 on T4, respectively. Both dropped significantly from their T1 assessment. Quite simply, participants recognize that the sun doesn't always shine and the wind doesn't always blow. Geothermal is also rated low for dependability (3.1). Coal, nuclear and natural gas are seen as the most dependable, receiving scores of 3.8, 3.8 and 3.7, respectively, in the T4 survey.

[20] The responses were reverse-coded from the original survey items for Dependability so that the most positive attributes would be equated with the highest number.

ENERGY SOURCE PROFILES

This section discusses each source from participant's viewpoint including their opinions about cost efficiency, dependability and impact on the environment. Further, participants discussed each of the eight energy sources during the three small group sessions at the Energy Forum. Results from both these inquiries are included in this section to provide a comprehensive presentation of participants' opinions of each of the eight energy sources.

Coal

Survey Results

Participants' perception of coal as an energy source is very straightforward (Figure 17). They see coal as dependable, relatively inexpensive and environmentally harmful. As participants gained additional knowledge about the strengths and weakness of coal as an energy source, through exposure to the energy booklet and participation in the Energy Forum, opinions shifted. Their perceptions of coal moved in the direction of being less expensive, more dependable and more harmful. In nearly all instances, these changes in opinion are statistically significant.

By the fourth survey (T4), 30 days following the Energy Forum, opinions about all three attributes moved in the opposite direction. That is, in the T4 interview, coal was perceived to be somewhat less dependable, more expensive and less harmful than it was immediately following the Energy Forum (T3). In short, opinions reverted back in the direction from which they started, before the educational process was initiated. Although, for dependability and expense, they did not revert entirely back to the participants' original opinions, measured in T1.

It is important to point out that even though opinions about coal were not as extreme as they appeared immediately following the Energy Forum, it is still viewed, very definitively, as a dependable, inexpensive and environmentally harmful energy source.

Figure 17.

Group Discussion

During the small group discussions, many Energy Forum participants were surprised to learn that coal is an abundant resource that can provide energy for Arizona well into the foreseeable future. Additionally, they noted that Arizona already has the infrastructure in place to perpetuate coal-generated energy, viewed as a big advantage compared against developing newer technologies for other energy sources.

Participants, however, also recognized the potential negative environmental and health impacts of burning coal for electrical generation. One participant asserted "not all coal is created equal; some coal is *really* dirty." As such, participants expressed interest in learning more about clean coal technology. During the small group discussions, some participants expressed the opinion that APS should invest in research and development to make coal safer for the environment and that public policy should focus on reducing emissions.

On the other hand, some participants felt that clean coal was simply "a farce, a marketing ploy by special interest groups." They acknowledged that coal provides a reliable source of energy while the state transitions to new technologies, but cautioned that overreliance on coal can slow progress towards renewable energy sources. While they clearly felt that no new coal plants should be built, they agreed that Arizona should continue to use existing plants.

Participants also raised questions about social justice in relation to coal production. Many questioned how reducing coal dependency would affect the job market, especially in Navajo Nation where coal production in a major employer. Others admitted that they were unfamiliar with coal plant locations. One participant commented: "Coal mining and production is invisible to most of us. We don't know where these plants are because we don't live near them and we don't have to work at them. But what will happen to the people who do work in this industry? What is the social justice impact?"

Geothermal Power Plants

Survey Results

Geothermal electrical generation is perceived to be "somewhat" inexpensive, "somewhat" dependable and not very harmful to the environment (Figure 18). Across the four surveys, participants' opinions about geothermal expense and harmfulness remained consistent. Following the Energy Forum, however, perceptions of its dependability decreased significantly.

Before the participants began to read about energy sources, and before attending the Energy Forum, most wanted to increase APS's use of geothermal as an energy source. Following the Energy forum, however, they were far less inclined to want to do so. On the final survey some participants still advocated for increased use of geothermal, but at a modest level.

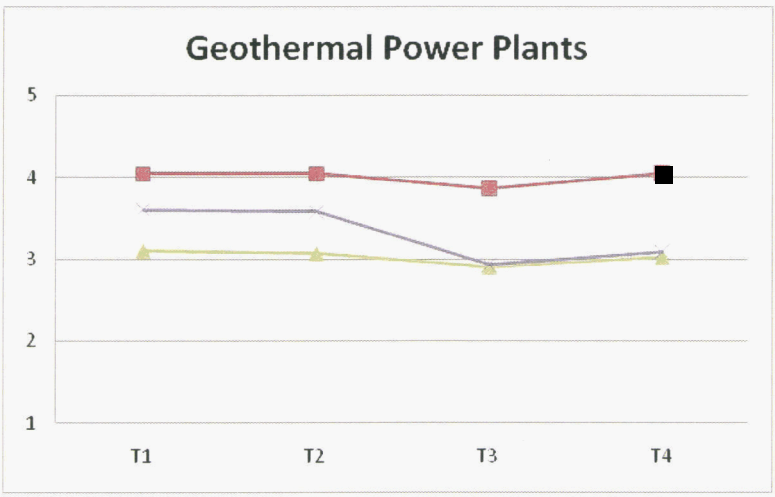


Figure 18.

Small Group Discussion

Although many participants did not fully understand geothermal energy, they maintained that because it is a renewable resource, it should not be ruled out as an energy source in which APS should invest. Based on the information acquired at the Energy Forum, participants generally felt that there is not enough geothermal energy available in Arizona to be considered a significant resource and that APS should use it to supplement existing resources in their portfolio. Some participants expressed concerns about the ramifications of extracting heat from within the earth and questioned whether enough is known about the long-term effects of geothermal technology.

Hydro Power Plants

Survey Results

Much like geothermal, hydro power receives a somewhat neutral evaluation (Figure 19). It is not seen as harmful, but viewed as moderately expensive and reasonably dependable. Between the first poll and the last, participants' view of hydro power's harmfulness varied a bit. It was viewed as somewhat more harmful following the booklet and the Energy Forum, but by the time the final poll was taken, it had reverted to a less-harmful position.

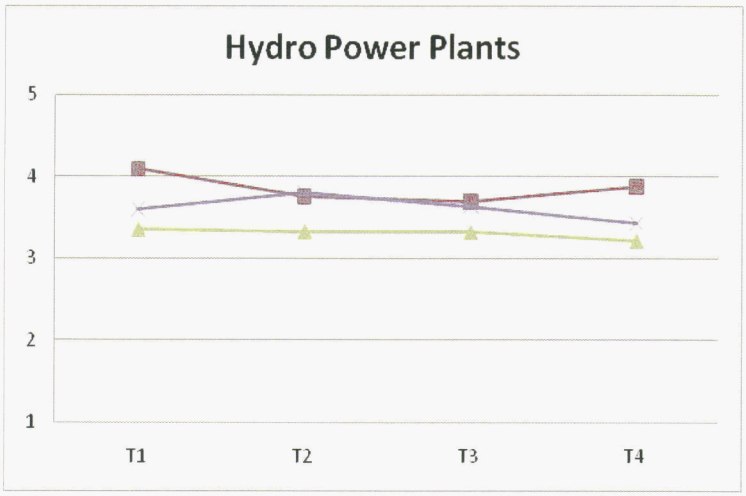


Figure 19.

Small Group Discussion

Participants suggested environmentalists will strongly oppose any major hydro power construction in Arizona because water is such a scarce resource and dams have negative impacts on fish and other wildlife. Participants were surprised to learn, however, that Arizona does not get electricity generated from the Hoover Dam.

Natural Gas

Survey Results

There is no significant change in opinion about natural gas (Figure 20) between the first poll (T1), when participants had no detailed knowledge of energy planning, and the last (T4), after they had read the booklet, attended the Energy Forum and spent a month without any formal energy education. Between the two (T2 and T3), however, opinions shifted. Perceptions of natural gas' dependability rose, while perceptions of its harmfulness declined. But, after a month away from energy planning exposure, opinions reverted to pre-treatment levels. That said, in spite of some concerns, the survey data give natural gas a relatively positive review, particularly as a non-harmful, dependable energy source.

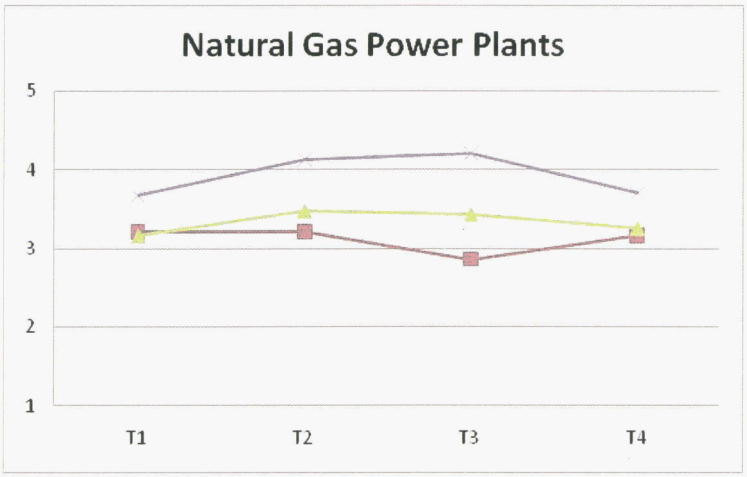


Figure 20.

Small Group Discussion

To most participants, the major problem with relying on natural gas for electricity generation is its price instability. Many have seen their gas bills fluctuate widely with changes in natural gas rates over the years and are concerned that prices in natural gas are too unpredictable to plan major, large-scale energy projects around. Others expressed concerns about the high cost of developing natural gas plants and suggested that capital could be invested in more financially stable sources.

Participants agreed that natural gas is less polluting than coal but shared considerable concerns about its safety in homes and businesses. There is clearly confusion between natural gas residential service and natural gas used by the natural gas electricity generating plants. For example, one participant noted a recent gas explosion in a California neighborhood that she described as "very scary." Another participant maintained that natural gas was indeed safe and that explosions mostly occurred from pipeline ruptures associated with poor maintenance of gas lines.

Some participants believed that natural gas plants require fewer jobs than other resource plants. Thus, investing in new natural gas plants would have a smaller impact on job growth than investing in nuclear or solar plants.

Nuclear Power

Survey Results

Nuclear power is perceived as a dependable energy source (Figure 21). And, as participants became more knowledgeable, their opinions about nuclear power's dependability rose. As is true with most variables in this study, however, in the final survey (T4), opinions began to revert to their starting point (T1). Even so, participants' beliefs about nuclear power's dependability rose significantly between the first survey (T1) and the last (T4).

Nuclear power is perceived to be more expensive than any of the energy sources tested. Participants' opinions about expense moderated somewhat following exposure to the booklet and attendance at the Energy Forum, but reverted to the pre-treatment level in the final survey (T4). While not perceived to be as harmful as coal, nuclear is seen as the second-most harmful energy source of the seven tested.[21] Perceptions of nuclear power's harmfulness stayed relatively flat across all four surveys.

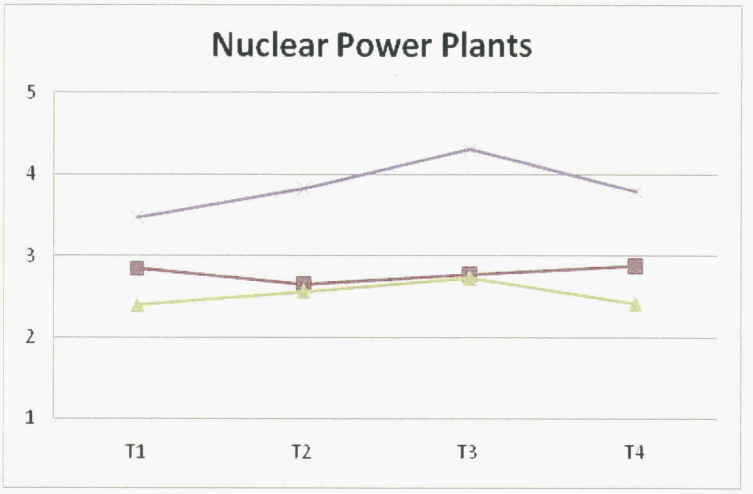


Figure 21.

Small Group Discussion

During the discussion groups, some participants expressed the belief that nuclear energy provides cheap, clean and reliable electricity. In fact, one participant asked, "Why did we ever stop building nuclear plants?" However, in the surveys, nuclear power was perceived to be the

[21] Energy efficiency was not measured on the harmfulness scale

most expensive of the eight energy sources presented. Additionally, nuclear energy evoked more NIMBY (not in my backyard) complaints than any other resource. Participants mentioned fears about radiation and contamination during the discussions. They noted that nuclear waste does not just "go away" and expressed concerns with the industry's ability to store nuclear waste safely over long periods of time. One participant commented, "It's not ethically responsible to build additional nuclear facilities when there is no good plan to deal with the waste." A few participants suggested looking to other countries like China and France, who rely heavily on nuclear energy, to develop additional waste storage technologies.

Some participants believed nuclear facilities were targets for terrorist attacks and raised issues about national security. Others were concerned with the volume of water nuclear plants use to produce electricity.

Some participants believed that nuclear development would positively impact the economy by creating high-wage jobs. However, most agreed that if Arizona invests in additional nuclear power, the power should stay in Arizona, not be sold to neighboring states. One participant noted that if Arizona chooses to invest in additional nuclear power, it should also invest in higher education so that there is a sufficient pool of engineers to manage these plants and identify innovative nuclear waste storage solutions.

Solar Power

Survey Results

Solar was perceived to do little harm to the environment when participants were first queried (T1), prior to exposure to any energy planning educational material (Figure 22). Following exposure to the educational material, that perception persisted across the remaining three polls.

Perceptions of solar power's costs are comparable to geothermal, hydro and natural gas. Cost perceptions did not vary from survey to survey.

Participant views of solar power's dependability did, however, change measurably between the first (T1) and second survey (T2). Prior to exposure to the energy booklet, solar power was viewed as very dependable. In fact, in the first survey (T1), solar was viewed as the most dependable source of the seven tested. By the second survey (T2), following exposure to the booklet, solar was rated as the second *least* dependable, trailing only wind power.

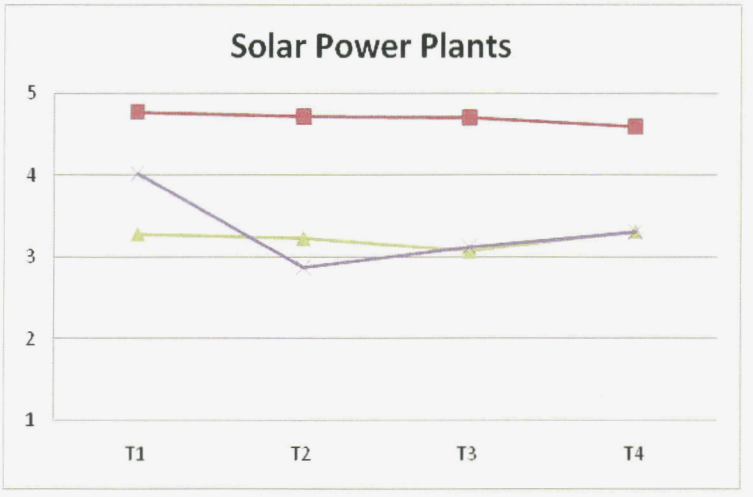


Figure 22.

Small Group Discussion

Participants were generally surprised to learn that solar energy accounts for only 3% of APS' energy portfolio mix. One participant said, "It's a natural thing to think that Arizona is the prime location for solar energy," since we get more than 300 days of sunshine. Generally, participants understood and agreed that other energy sources are needed to ensure a reliable flow of electricity. They noted that solar energy is not available at night and that storage technologies are not yet mature.

While both the energy booklet and the Energy Forum addressed solar in the larger context and as a part of the power grid, many participants still view solar from a "panels on rooftops" perspective. As a result, part of the small group discussion about solar energy centered on individual solar usage rather than solar in the larger context.

Several participants agreed they needed more information about solar power before they felt able to determine if an individual investment in solar energy was right for them. For example, people asked questions like: "How much do solar panels cost? What is the return on investment? What tax breaks are available? What maintenance is required for solar panels? How long will my panels last and how frequently do I have to and service them? What is the process for selling my excess power to APS?"

A few participants spoke about their experiences with solar panels and raved about the energy they are generating and the money they are saving. When asked if there were any downsides to installing solar panels, the participants answered that the initial upfront cost can be a barrier for many people. One participant felt that "those in the higher economic brackets will have to take the first step to adopt these new technologies to drive down the costs and barriers for other consumers." Still, many felt that a lack of investment in solar technology is not socially responsible. One person commented, "We should build solar because it's the right thing to do."

Wind Turbines

Survey Results

Like solar and energy efficiency, wind power is perceived as "environmentally friendly." And, while that perception persisted across all four surveys, it did erode slightly between the first survey and the last (Figure 23). Even so, it is seen as a non-harmful power source. Wind is also seen as relatively inexpensive when compared against the other seven energy sources tested. The perceived expense is roughly the same as that for natural gas.

Like the perception of wind's harmfulness – or lack thereof – the perception of its expense did not change over the four surveys. Wind's dependability, on the other hand, scores the lowest of the seven energy sources tested.[22] While wind's dependability was above a 3, on the 5-point scale, in the first survey it dropped significantly following participant exposure to the booklet and remained there through the final two surveys.

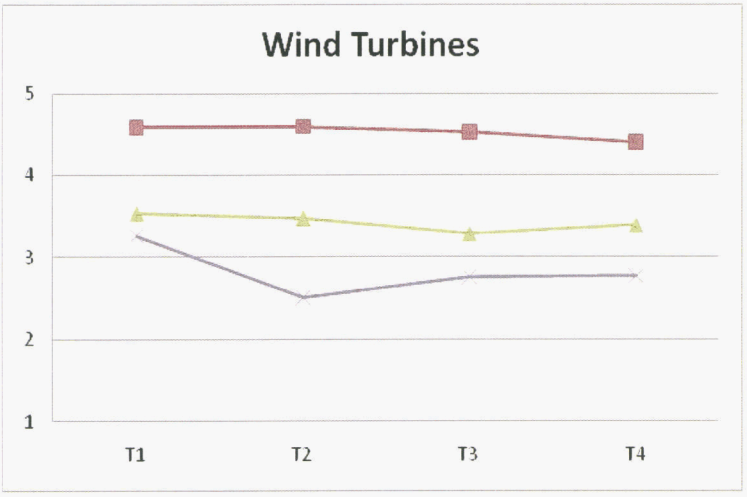


Figure 23.

Small Group Discussion

Participants were generally positive about wind energy and felt that wind could be a great resource to meet Arizona's electricity needs. They commented that wind is abundant in certain parts of Arizona such as Eloy, the Petrified Forest and Holbrook. These communities have the greatest potential for producing valuable wind energy for the state. The primary concern expressed by participants with wind energy was that wind is an intermittent resource and therefore cannot be solely relied upon to be a significant energy provider. Other downsides to wind energy were NIMBY issues related to wind turbines, the acreage needed to develop large-scale wind farms, the destruction of birds and the need for additional transmission lines. Some participants believed that APS should not invest money in wind farms but instead wind farms should be privately owned and should sell energy to the utilities.

[22] Energy efficiency was not tested for dependability

Energy Efficiency

Survey Results

Energy efficiency was measured on only two scales, harmfulness and expense (Figure 24). For both measures energy efficiency scored at or near the top compared with the other seven energy sources. On the harmfulness scale it tracked upward from an already lofty position (4.4 on a 5-point scale) and finished even higher (4.6) by the time the last measure (T4) was taken.

Further, it is perceived as the least-expensive energy source among those tested. As is true of the perception of energy efficiency's harmfulness, perceptions of its expense improved as participants became more knowledgeable. While there was some drop-off between the third (T3) and fourth measurement (T3), perceptions of energy efficiency's harmfulness and expense were the best among the eight tested energy sources.

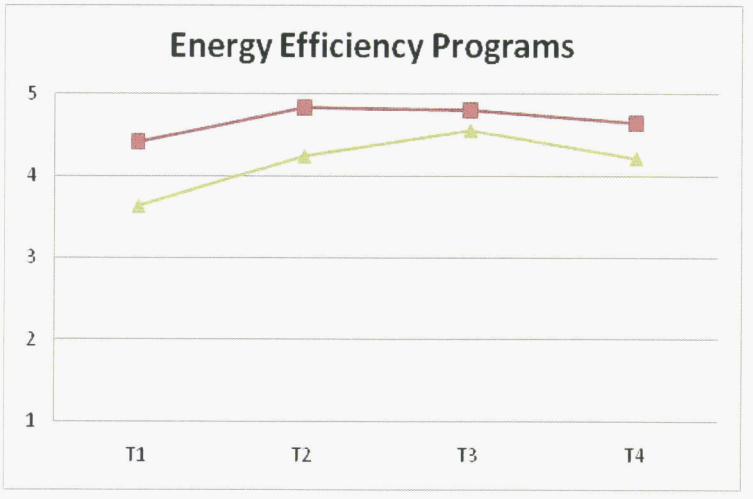


Figure 24.

Small Group Discussions

There was general agreement among participants that APS needs to do a better job educating people about Energy Efficiency as it relates to individual conservation efforts and as it relates to demand-side management. For many participants, the Energy Briefing Booklet and Energy Forum were their first introduction to energy efficiency as a resource. One participant said: "Eventually everyone will benefit from energy efficiency. If we use our energy more sparingly, we can offset some of the negative impacts of other portfolio assets." Some participants were concerned that APS is not offering the latest technology to customers that would aid them in being more energy efficient. Items mentioned were smart meters, advanced electricity monitoring systems and pre-paid electricity plans. Not all participants were excited about the concept of demand-side energy management. One commented: "We are all spoiled; we don't want to cut back usage." While another person concluded: "There should be a tax on energy gluttons." And still another said: "I'm willing to pay for the freedom to use electricity whenever I want it."

ATTITUDES ABOUT ENERGY RESOURCES AND USE

Participants were asked to state their degree of agreement on 18 statements, with 1 being "strongly disagree" to 5 being "strongly agree." Each of these 18 statements was tested on three of the four surveys – the baseline survey administered at the beginning of the project (T1), the survey immediately following the Energy Forum (T3) and the survey administered 30 days following the Energy Forum (T4).

Among the attitude/opinion questions, two areas emerged with the low levels of participant agreement:

- "Renewable energy is not worth the money it will take to develop it" (9% at T1, 5% at T3 and 11% at T4).
- "We have enough reserves of coal and natural gas in the U.S. to provide for our energy needs for centuries" (35% at T1, 40% at T3 and 39% at T4).

Alternatively, two areas demonstrated the highest levels of agreement among participants:

- "State and federal regulations affect electricity prices in Arizona" (90% T1, 93% T3 and 91% at T4).
- "I would not object to having solar panels installed on roofs in my neighborhood" (97% at T1, 95% at T3 and 97% at T4).

Effect of the Energy Form (T1 to T3)

From T1 survey administration to T3 administration, immediately following the Energy Forum, attitudes toward three statements showed significant change:

- "Arizona has rich deposits of coal" – an increase in agreement from 30% to 49%.
- "Utility companies have been paying too little attention to the benefits of increased energy efficiency and too much attention to developing new power sources" – a decrease in agreement from 44% to 30%.
- "I would be willing to pay more for electricity so that low-income households can buy electricity at a lower price than high-income households" – a decrease in agreement from 41% to 28%.

Most attitudes remained unchanged immediately following the Energy Forum.

One-month Follow-up Survey Administration (T4)

The majority of attitudes at the one-month follow-up interview (T4) remained consistent with attitudes immediately following the Energy Forum. However, five specific statements demonstrated significant changes from either T1 or T3 attitudes by follow-up survey administration:

- "Arizona has rich deposits of coal" – the T3 increase in agreement was maintained by T4 at 57%. This was a significant increase from 30% at T1.
- "Utility companies have been paying too little attention to the benefits of increased energy efficiency and too much attention to developing new power sources" – T3 levels of agreement were maintained by T4 at 30%, which was a significant decrease from 44% at T1.
- "Renewable energy is not worth the money it will take to develop it" – agreement significantly increased from 5% at T3 to 11% at Time 4, levels consistent with T1 agreement (9%).
- "I would be willing to have a power generating plant built near my home if it meant more jobs in my community" – agreement significantly increased from 46% at T3 to 61% at T4, levels consistent with T1 agreement (52%).
- "I would be willing to pay more for electricity so that low-income households can buy electricity at a lower price than high-income households" – agreement at T4 (41%) increased significantly from T3 (28%) to levels consistent with T1 (41%).

Description of Individual Attitude Statements

The following section describes participant responses on the 18 individual attitudes statements included in the surveys administered at T1, T3 and T4. Specific trends, whether increases or decreases in agreement, are noted for each figure provided. Additionally, participant insights captured during the moderated sessions at the Energy Forum are used to augment attitude statements described below.

Percentage agreement with "We have enough reserves of coal and natural gas in the U.S. to provide for our energy needs for centuries."

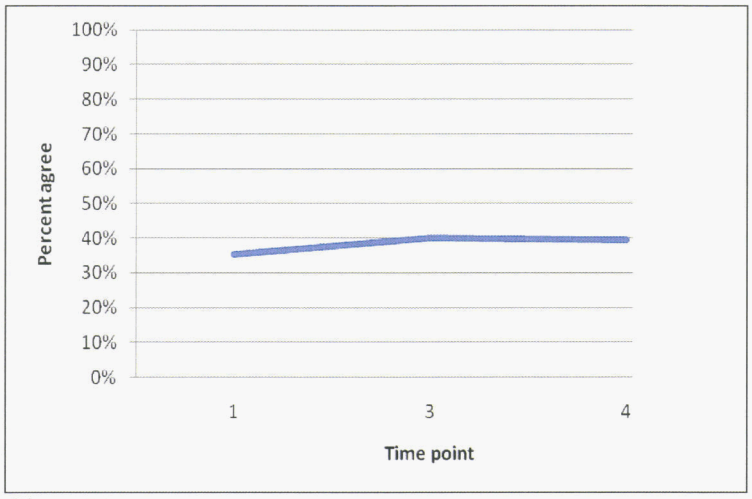


Figure 25.

Figure 25 indicates that by T3, 40% of participants agreed that reserves of coal and gas would be abundant for centuries, as compared to 35% at T1 (5% point difference; p = .39)[23]. This increase was maintained by T4, one month following the Energy Forum (T3-T4 1% point difference; p = .90).

Many Energy Forum participants were surprised to learn coal is an abundant resource that can provide energy for Arizona well into the foreseeable future. Additionally, participants noted that the state already has the infrastructure in place to continue coal generation, which is a big advantage over developing newer technologies. However, all participants recognized the potential negative environmental and health impacts of coal generation. As one participant pointed out "not all coal is created equal; some coal is *really* dirty." Consequently, participants expressed interest in learning about clean coal technology. They strongly felt that APS and the state should invest in research and development to make coal safer for the environment. However, there were some participants who felt that clean coal was simply "a farce, a marketing ploy by special interest groups." Regardless of the position taken, pollution from burning coal is a concern for APS customers.

Percentage agreement with "Arizona has rich deposits of coal."

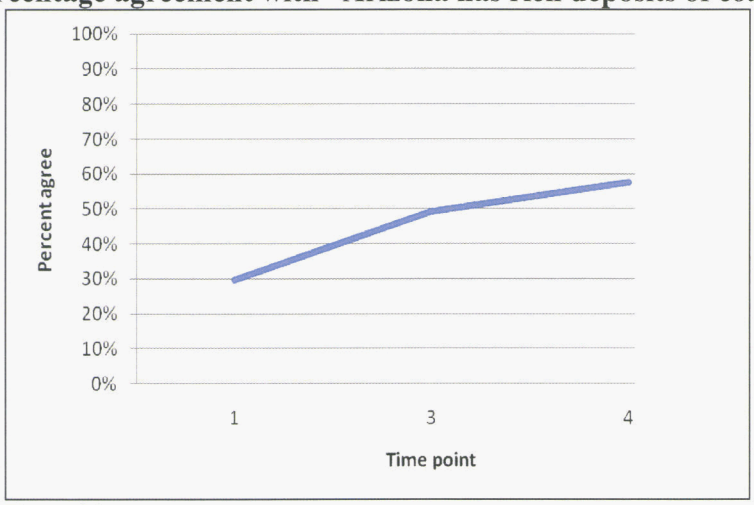


Figure 26.

In Figure 26, agreement among participants with the statement that Arizona has rich deposits of coal increased significantly, from 30% agreement at T1 to 57% agreement by T4 (27% point difference; p = .00). This upward trend increased steadily across all three survey administrations.

[23] The "p" values used throughout this report refer to whether differences in response to the same question, over time, are statistically significant (.05 or lower) or insignificant (higher than.05)

Percentage agreement with "Utility companies have been paying too little attention to the benefits of increased energy efficiency and too much attention to developing new power sources."

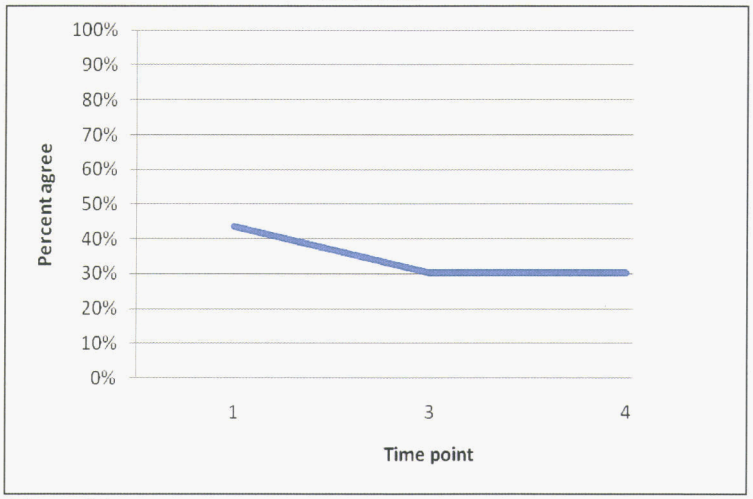


Figure 27.

Figure 27 shows agreement among participants that utility companies have been paying too little attention to energy efficiency and too much attention on developing new sources decreased significantly by T3, from 44% agreement at T1 to 30% agreement at T3 (14% point difference; p = .02). This decrease was maintained at 30% agreement by the final survey administration.

Percentage agreement with "Renewable energy is not worth the money it will take to develop it."

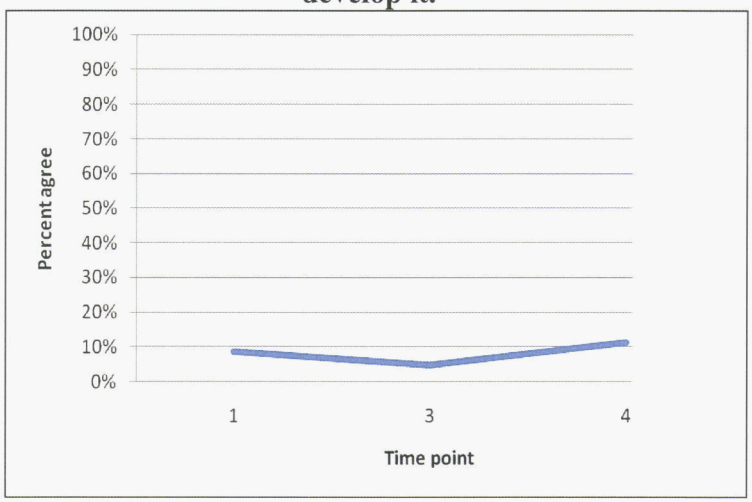


Figure 28.

Only a fraction (9%-11% between T1 and T4) in Figure 28 agreed with the statement that renewable energy is not worth the money to develop it. However, there was a small, yet significant, 6% increase in agreement between T3 and T4 (p = .03), immediately after the Energy

Forum and one month later. Even so, nearly nine in 10 participants did not see money as a barrier to the development of renewable energy sources.

People won't reduce their electricity use without government or utility incentives.

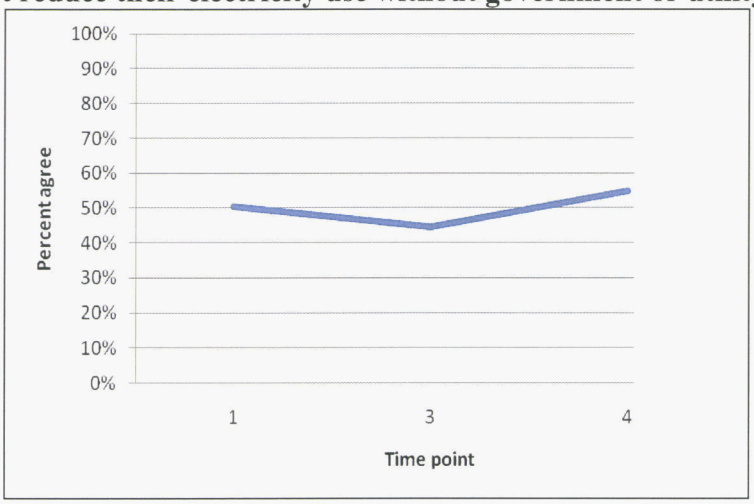


Figure 29.

At T1 in Figure 29, 50% of participants agreed that individual reductions in energy use would require incentives. This level of agreement showed a small dip immediately following the Energy Forum (44% at T3; p = .30) and increased only slightly, to 55%, by T4 (p = .42).

Percentage agreement with "In the future, the relative price of electricity will be higher than it is today."

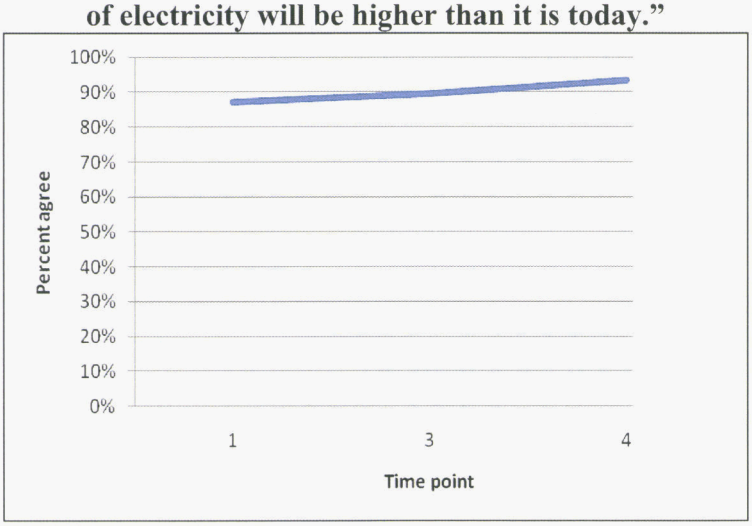


Figure 30.

An overwhelming majority of participants at each survey administration in Figure 30 indicated that prices for electricity will be higher in the future. By T4, one month following the Energy Forum, rates of agreement are generally uniform among all of the participants completing the final survey at 94% (T1-T4 7% point difference; p = .05).

Percentage agreement with "When I consider electricity, the most important thing to me is the amount of my monthly bill."

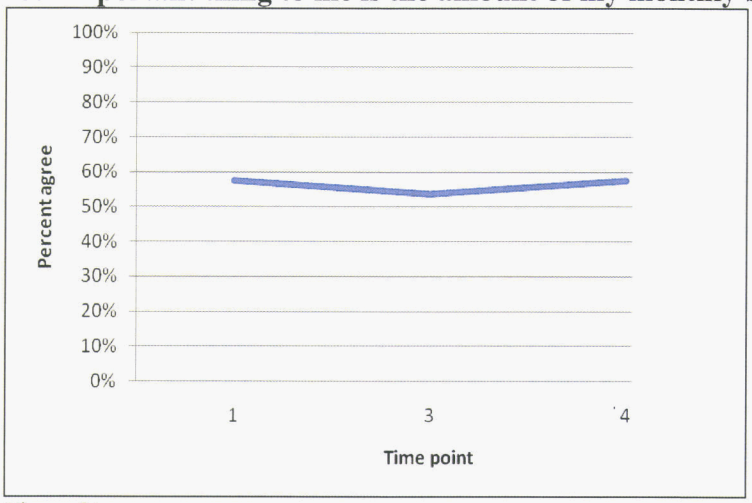


Figure 31.

In Figure 31, over half of the participants are primarily concerned with the amount of their monthly bills at each time point, ranging between 54% agreement and 57% agreement. There was no significant change in levels of agreement across each survey administration time point (T1-T4 0% point difference; p = 1.0).

Percentage agreement with "State and federal regulations affect electricity prices in Arizona."

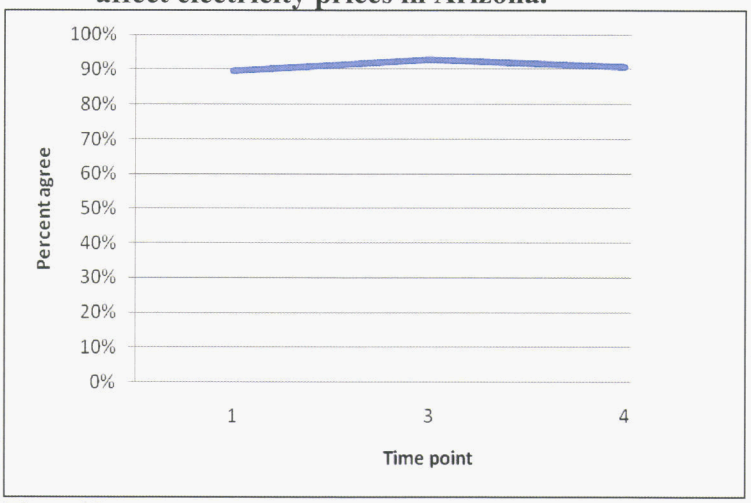


Figure 32.

Figure 32 demonstrates that most participants agree that state and federal regulations affect electricity prices in Arizona. These high levels of agreement, between 90% and 93%, occurred at each survey administration (T1-T4 1% point difference; p = .70).

Percentage agreement with "Arizona should produce all the electrical energy it needs within the state."

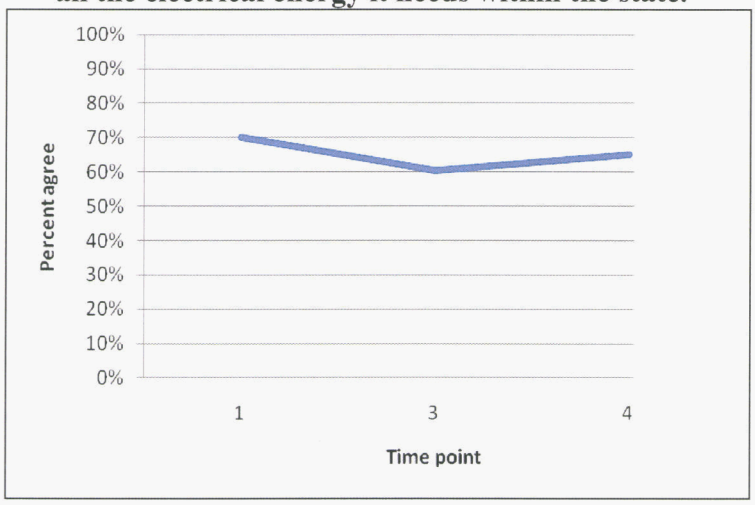


Figure 33.

Seventy percent of participants in Figure 33 felt that Arizona should produce all of the electricity it needs in-state at T1. Rates of agreement with this statement dropped by T3 and T4, but only by 5% to 10% ($p = .33$ and .07, respectively). Overwhelmingly, participants believe electricity production should primarily remain within Arizona.

Percentage agreement with "I would be willing to have a power generating plant built near my home if it meant more jobs in my community."

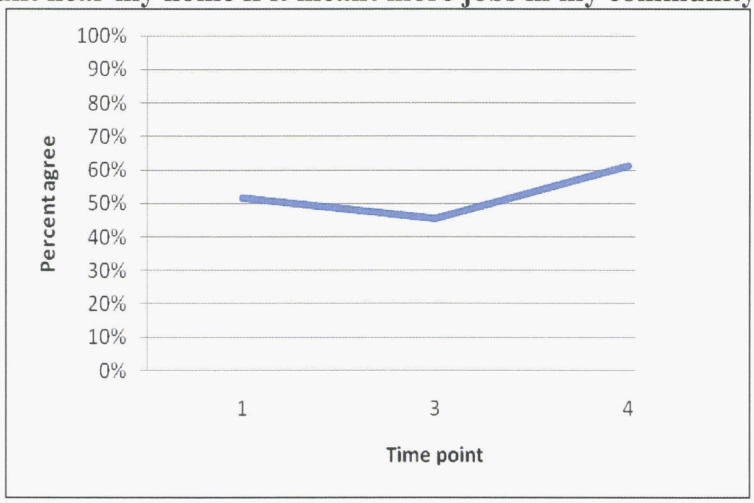


Figure 34.

In Figure 34, the percentage of participants willing to have a power generating plant in their communities for the sake of job production increased significantly, from 46% at T2 to 61% one month following the Energy Forum (15% point difference; $p = .01$).

Percentage agreement with "I would not object to having a wind farm located near my home."

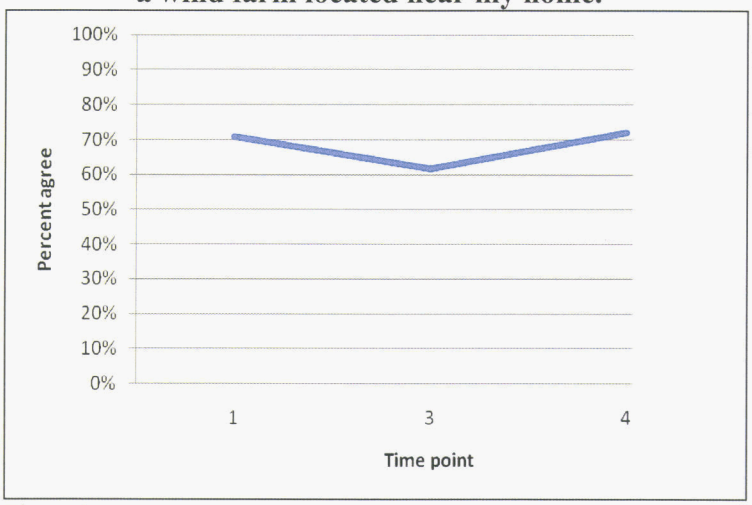


Figure 35

Nearly two-thirds of participants at T1 and T4 (71% and 72%, respectively) in Figure 35 reported agreement with having wind farms in their communities. The rate of agreement dropped by 9% immediately after the Energy Forum ($p = .09$); however, this decrease was not maintained by the final survey administration (T3-T4 10% point difference; $p = .05$).

Percentage agreement with "I would not object to having solar panels installed on roofs in my neighborhood."

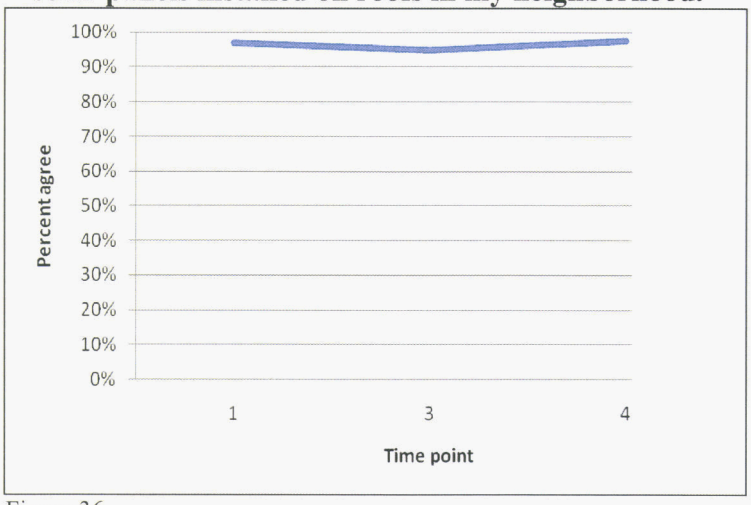


Figure 36.

The vast majority of participants in Figure 36 reported agreement with having solar panels installed on neighborhood roofs, with percentages upwards of 95%-97% at each survey administration (T1-T4 $p = .74$).

Percentage agreement with "I would be willing to pay more for electricity so that low-income households can buy electricity at a lower price than high-income households."

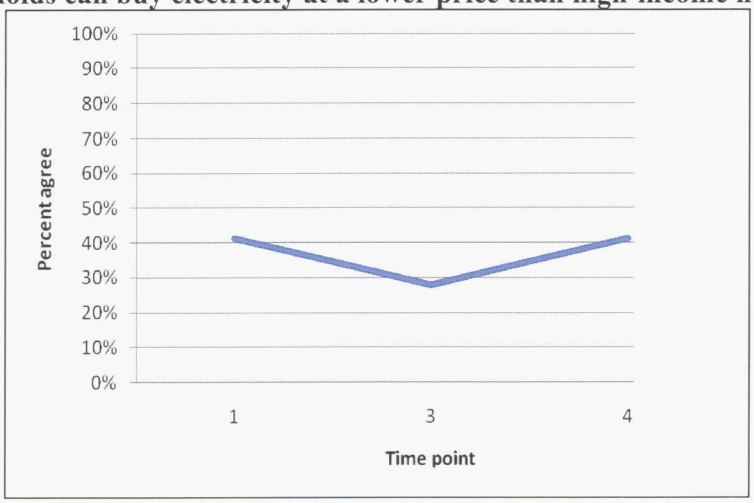


Figure 37.

Less than half the participants in Figure 37 were willing to pay more for electricity to allow low-income households to purchase electricity at a lower price, with 41% agreement at T1 and T4 (0% point difference; p = 1.0), and a significant drop in agreement at T3, immediately following the Energy Forum (T1-T3 14% point difference; p = .01).

Percentage agreement with "I would be willing to pay more for electricity from sources that consume little or no water."

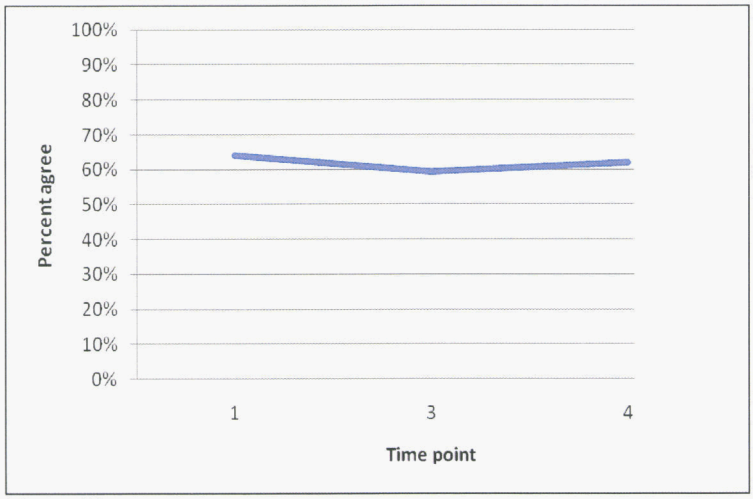


Figure 38.

At each time point in Figure 38, most participants reported a willingness to pay more for electricity from resources that consume little water, with rates of agreement between 59% and 64% (T1-T4 2% point difference; p = .72).

Percentage agreement with "We should reduce our use of coal to generate electricity to decrease pollution in Arizona."

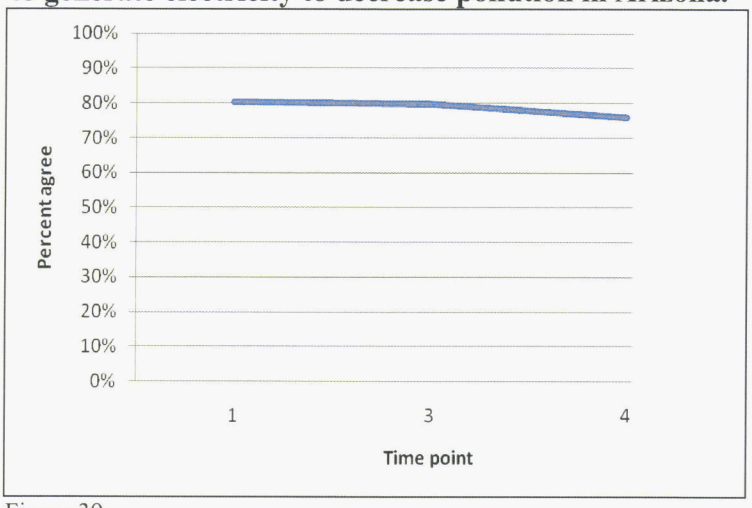


Figure 39.

In Figure 39, 8 of 10 participants at each survey administration reported agreement with reducing use of coal in an effort to decrease pollution in Arizona. By T4 administration of the survey, fewer participants reported agreement with reducing coal use. This downward trend, while non-significant, is consistent with the observed lower perceptions of coal's harmfulness to the environment one month following participation in the Energy Forum and reviewing the Energy Briefing Book (see Figure 13 in section ENERGY SOURCE PROFILES).

Percentage agreement with "A permanent site to store nuclear waste should be developed before constructing new nuclear power plants in Arizona."

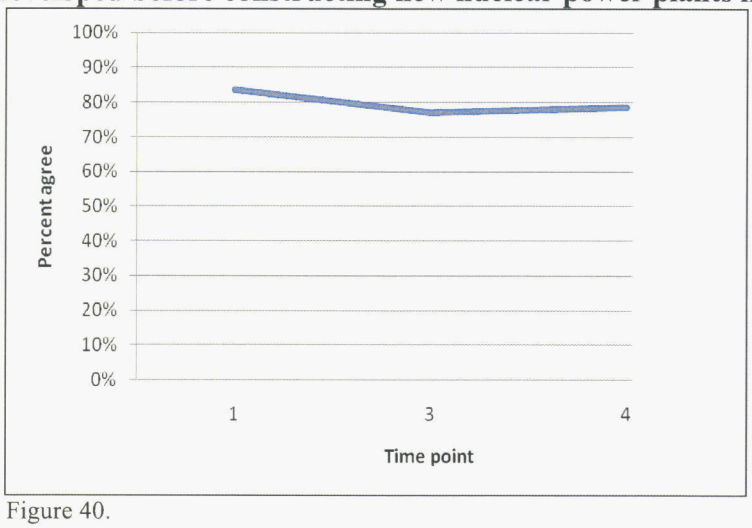


Figure 40.

The majority of participants agreed that permanent sites for nuclear waste storage should be determined before new facilities are constructed. These agreement rates (between 77% and 84%)

were maintained at each survey administration (T1-T4 6% point difference; p = .24). As stated earlier in this report, this does not factor in the effects of the Japanese nuclear crisis following the March 11, 2011, earthquake and tsunami.

Percentage agreement with "The state of Arizona should encourage the shift to renewable energy resources by continuing to require that a certain percentage of electricity be generated from renewable sources."

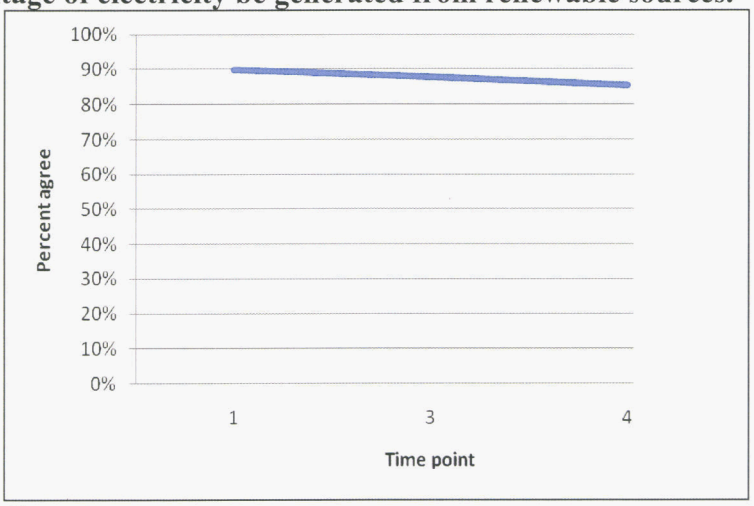


Figure 41.

The vast majority of participants in Figure 41 reported a desire for Arizona to encourage more renewable energy use by requiring that a percentage of electricity be produced from renewable resources. This was a consistent finding across all time points, with agreement rates ranging from 85% to 90% (T1-T4 5% point difference; p = .23).

Percentage agreement with "I would be willing to pay more on my monthly power bill to fund rebates that lower the purchase cost for those who install solar panels at their home or business."

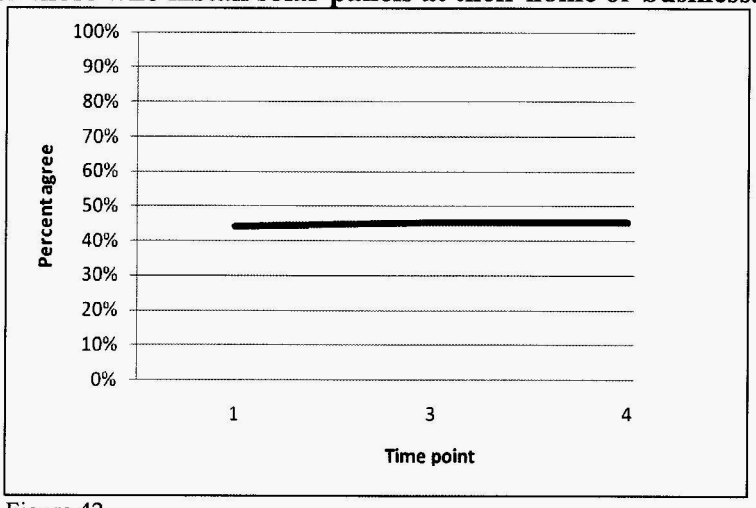


Figure 42.

Fewer than half of participants in Figure 42 at each time point reported a willingness to pay more per month to fund rebates for those that install solar panels on their homes or businesses. There was no shift in opinion across all three surveys (T1-T4 2% point difference; $p = .82$).

THE EFFECTS OF EDUCATION ON OPINIONS AND ATTITUDES

One goal of this project was to determine whether educating utility customers about energy and energy planning would impact their attitudes, knowledge and opinions about energy. And if so, what would the measurable impact be. Further, we wanted to determine whether those changes in attitudes and opinions would persist over time.

Changes in Attitudes and Opinions from Survey to Survey

Participants were given two educational treatments to increase their knowledge of sources, energy and energy planning. First, participants received the Energy Briefing Book, produced by Morrison Institute in partnership with the Collaborative Committee, immediately following the initial survey (T1). Next, participants attended the daylong Energy Forum, which included two panel discussions with energy experts and three 1- to 1½-hour-long, small group discussions about energy and energy planning.

These educational experiences resulted in shifts in knowledge, attitudes and opinions in the short term. However, those shifts vanished or were tempered over time – reflected in their attitudes and opinions 30 days following the Energy Forum (T4). With only a handful of exceptions, changes in attitudes and opinions were modest when comparing where participants stood on issues in T1 and where they stood on those issues in T4. For many of the variables, analysis shows no significant change in attitude or opinion from the initial measurement (T1), when most participants knew little or nothing about energy and energy planning, to the fourth survey (T4), after they had been exposed to a great deal of information about energy and energy planning. In short, many changes in attitudes and opinions didn't stick; they were short-term, suggesting that affecting permanent changes in attitudes and opinions requires ongoing reinforcement, at least until those new attitudes and opinions become a part of the individual's belief system.

Further, results of the education process show an effect for participants who responded with "I don't know" on the initial questionnaire (T1). As demonstrated in Table 2, for almost every energy source where the attitudes about usage, harmfulness, expensiveness and dependability were measured, there was a significant reduction in the number of participants reporting no opinion or "I don't know" between the first (T1) and last (T4) surveys. The following table reports the percentages of people who answered "I don't know" for surveys T1 and T4.

Percentage Of Sample That Responded "I Don't Know"

		Coal	Geo	Hydro	Gas	Nuclear	Solar	Wind	Energy Eff
Usage	T1	2.7	14.7	1.6	3.3	3.8	0.5	3.3	n/a
	T4	0.6	11.0	4.4	3.8	0.6	1.3	1.3	n/a
Harmfulness	T1	1.1	9.8	1.1	1.6	0.5	2.2	3.8	14.7
	T4	0.6	4.4	1.3	1.3	0.6	1.3	0.6	1.9
Expensiveness	T1	9.8	20.7	11.4	7.6	8.2	7.1	7.6	17.9
	T4	0.0	7.5	3.8	1.9	1.3	0.0	0.6	1.3
Dependability	T1	2.7	16.3	1.6	1.6	2.2	0.5	0.5	26.6
	T4	0.0	8.2	1.3	0.6	0.0	1.3	0.6	5.7

Table 43.

As Table 43 shows, between T1 and T4 the percentage of participants who "didn't know" or didn't have an opinion was reduced across most energy sources, with the exception of usage of hydro, natural gas and solar; the harmfulness of hydro and nuclear; and the dependability of solar and wind. For those questions, a comparable percentage of participants (comparing T1 with T4) were unable to form an opinion even after exposure to the education treatments. However, the largest reductions in the percentage of participants who "didn't know," were related to energy efficiency and the cost of energy sources, indicating that these were topics participants knew the least about at the beginning of the study, thus they made the greatest gains in forming an opinion by T4. Overall, these reductions in "I don't know" responses indicate that many people who hold no opinion prior to educational exposure will form an opinion that is sustainable over time after educational exposure.

Impact of the Energy Briefing Book on Perceptions of Sources (T1 to T2)

So, overall, how much impact did the Energy Briefing Book have on attitudes and opinions? In addition to the response changes among participants who responded, "I don't know," in T1, there were some statistically significant changes in opinions and attitudes between the time of the first survey (T1) and the second (T2). Between the two measures participants were provide a copy of the Energy Briefing Book – the only energy education item provided to them by the research team during this time period. Obviously it is difficult to attribute any or all changes in attitudes and opinions to a single variable (the book). However, the book specifically addressed energy and energy planning, so we surmise that changes in attitudes and opinions were, in all likelihood, the result of exposure to the booklet.

Importance of Issues

The Energy Briefing Book had minimal impact in changing opinions about what participants consider important related to energy. Of the 10 items tested for importance, opinions about only one item changed significantly following exposure to the book. Participants felt that "keeping electricity rates low for consumers" was a more important issue after reviewing the book (T2)

compared with how they felt prior to receiving it (T1). However, immediately following the Energy Forum (T3), opinions about this issue returned to the pre-book level (T1) and, 30 days following the Energy Forum (T4), the level of importance afforded this issue continued to regress to T1 levels. There was no significant change in opinion for any of the other nine "importance" items tested.

Harmfulness of Energy Sources

Changes in opinions about the harmfulness of three of the energy sources occurred between T1 and T2 – nuclear, energy efficiency and hydro. Perceptions of harmfulness increased during that time period for nuclear power and hydro plants, while it declined for energy efficiency. It is important to point out that while there was some statistically significant shifting of attitudes and opinions, these shifts were relatively small and did not seriously alter the participants' overall view of the harmfulness, or lack thereof, of the tested energy sources.

Expense in Producing Power from Energy Sources

Opinions about the expense for producing power from coal and from natural gas changed from T1 to T2. In both cases the perception of the expense declined – that is the cost of production was perceived to be cheaper after exposure to the Energy Briefing Book. The perceived cost for energy efficiency was also reduced after exposure to the book.

Dependability of Energy Sources

The perceived dependability of coal, gas and nuclear power rose following exposure to the Energy Briefing Book. The perception of the dependability of solar and wind, on the other hand, dropped precipitously, solar by more than a full point and wind by three-quarters of a point. Even taking all the variables from the study into consideration, this is one of the biggest changes seen in the study.

Impact of the Energy Forum on Perceptions of Sources (T2 to T3)

Did the Energy Forum impact attitudes and opinions? For some variables there were changes, but for most, attitudes and opinions stayed where they had started at the beginning of the day.

Importance of Issues

For two of the tested variables, "keeping electricity rates low for customers" and "avoiding facilities that detract from the scenic beauty of Arizona," participants' rating of importance declined significantly. In the T2 survey – prior to the Energy Forum - 80% of participants rated "keeping electricity rates low for customers" as important but, following the Energy Forum (T3), only 67% rated it as important. "Avoiding facilities that detract from the scenic beauty of Arizona" dropped from 45% considering it important on the T2 survey to 32% on the T3 survey. There was no significant change for any of the other eight importance topics.

Harmfulness of Energy Sources

Opinions about the harmfulness of the energy sources were essentially unaffected by the information participants acquired during the Energy Form. Opinions changed significantly only for natural gas. Following the Energy Forum, perceptions of natural gas' harmfulness decreased.

Expense in Producing Power from Energy Sources

Opinions about the expense of producing power from the energy sources remain unchanged for all eight sources comparing the results from surveys T2 and T3.

Dependability of Energy Sources

The Energy Forum did have effects on perceptions of dependability, although none changed to the degree that the overall perceptions of the sources' dependability were altered dramatically. Four of the sources – coal, nuclear, solar and wind – were perceived to be more dependable following the Energy Forum (T3) than just prior to it (T2). For solar and wind, this rise followed a precipitous drop following exposure to the Energy Briefing Book – between T1 and T2. Consequently, while there was a slight rise in perceptions of the dependability of solar and wind, there remained a significant drop from T1 to T3. There was a significant drop in the perception of the dependability of geothermal following the Energy Forum (T3), as well.

Impact of Briefing Book/ Energy Forum on Perception of Sources (T1 to T4)

While there were attitude and opinion changes throughout the educational process, 30 days or more following the process, some participants' opinions and attitudes reverted to pre-study levels. The education process serves to alter attitudes and opinions as the process is ongoing, but once that process ends, there is a "snap-back" effect – many attitudes go back to where they started.

For only two of the opinion/attitudes questions about energy, among the 18 asked, did participant opinions change significantly from the first (T1) to the final (T4) survey. For the other 16 questions, participants' opinions were the same in the first and last surveys despite the fact that they had gone through two educational processes – the Energy Briefing Book and the Energy Forum.

Among the nine "concerns" questions, there was no instance of a concern changing significantly when comparing the initial response to the question, the first survey (T1), and the last (T4).

For only two of the 10 "importance" questions was there a statistically significant difference when comparing the initial responses (T1) with the responses on the last survey (T4).

In measuring participants' perceptions of the attributes of each energy source – harmfulness, expense and dependability – there were numerous instances of significant shifts of opinion from their initial position (T1) to their final one (T4). When measuring harmfulness there were statistically significant changes for four of the eight sources comparing the first survey (T1) to the last (T4). For the expense variable there was a statistically significant change for two of the eight sources and for dependability, five significant changes among the seven energy sources tested (energy efficiency was not tested for dependability).

In summary, some attitudes and opinions about the eight energy sources tested in this research shifted during the study period (from T1 to T2 and T2 to T3), presumably as a result of the two education treatments – the Energy Briefing Book and the Energy Forum. And, the majority of participants who expressed no opinion (those who answered "don't know" to questions) showed the largest changes in response – shifting from holding no opinion to forming an opinion. Therefore, in this study education promulgated real, sustained benefits for those with no knowledge of specific energy information. The education process can also alter opinions of those who already hold opinions but, when the education process ceases, many opinions go back to where they started. Again, continued education appears to be critical if opinion/attitude changes are to be sustained.

APPENDICES

APPENDIX A: Surveys T1-T4

Survey T1

BEHAVIOR RESEARCH CENTER, INC. JOB ID 2010062
45 East Monterey Way MORRISON INSTITUTE FOR PUBLIC POLICY
Phoenix, AZ 85012 APS
(602) 258-4554 BASELINE (T-1)

Hello, my name is _____ and I'm with Behavior Research Center an Arizona market research firm. We're conducting an important study on behalf of the Morrison Institute at Arizona State University. May I speak with the (MALE/FEMALE) head of the household?

1. *In Arizona we currently generate electricity from several different resources. To the best of your knowledge, from which* of the following does most of our electricity come from? (READ LIST, ROTATE AND RECORD ONLY ONE ANSWER)

Coal power plants...1
Geothermal power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated from the earth's natural underground heat)...2
Hydro power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated when water passes through a dam)...3
Natural gas power plants...4
Nuclear power plants...5
Solar power plants...6
Wind turbines...7
(DO NOT READ) Don't know/refused...8

2. And, which one of these resources do you believe is the second most used for generating electricity? (ELIMINATE CHOICE FROM Q1; READ LIST)

Coal power plants...1
Geothermal power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated from the earth's natural underground heat)...2
Hydro power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated when water passes through a dam)...3
Natural gas power plants...4
Nuclear power plants...5
Solar power plants...6
Wind turbines...7
(DO NOT READ) Don't know/refused...8

3. Which two of the following resources do you believe are least used for generating electricity in Arizona (ELIMINATE ANSWERS TO Q1 AND Q2; READ LIST)

Coal power plants...1
Geothermal power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated from the earth's natural underground heat)...2
Hydro power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated when water passes through a dam)...3
Natural gas power plants...4
Nuclear power plants...5
Solar power plants...6
Wind turbines...7
(DO NOT READ) Don't know/refused...8

4. Arizona electric utilities offer incentives to consumers to encourage use of energy efficient appliances or equipment. Like other resource investments, all utility customers pay for these incentives. In the future, do you believe Arizona should increase its use of these energy efficiency incentive programs, reduce its use of energy efficiency incentive programs, or continue as we do now?

Increase...1
Continue as now...2
Reduce...3
Don't know/refused...4

5. Looking into the future, for each of the following resources, do you believe Arizona should increase its use of, reduce its use of or continue as we do now? (READ EACH; ROTATE)

		Increase	Continue As Now	Reduce	Don't Know/ Refused
a.	Coal power plants	1	2	3	4
b.	Geothermal power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated from the earth's natural underground heat)	1	2	3	4
c.	Hydro power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated when water passes through a dam)	1	2	3	4
d.	Natural gas power plants	1	2	3	4
e.	Nuclear power plants	1	2	3	4
f.	Solar power plants	1	2	3	4
g.	Wind turbines	1	2	3	4

6. On a scale of 1 to 5 where 1 means least harmful to the environment and 5 means most harmful, how would you rate each of the following: (READ EACH; ROTATE)

		Least Harmful				Most Harmful	Don't know/ Refused
a.	Coal power plants	1	2	3	4	5	6
b.	Geothermal power plants	1	2	3	4	5	6
c.	Hydro power plants	1	2	3	4	5	6
d.	Natural gas power plants	1	2	3	4	5	6
e.	Nuclear power plants	1	2	3	4	5	6
f.	Solar power plants	1	2	3	4	5	6
g.	Wind turbines	1	2	3	4	5	6
h.	Energy efficiency programs	1	2	3	4	5	6

7. On a scale of 1 to 5, where 1 means least expensive and 5 means most expensive, how would you rate each of the following: (READ EACH; ROTATE)

		Least Expensive				Most Expensive	Don't know/ Refused
a.	Coal power plants	1	2	3	4	5	6
b.	Geothermal power plants	1	2	3	4	5	6
c.	Hydro power plants	1	2	3	4	5	6
d.	Natural gas power plants	1	2	3	4	5	6
e.	Nuclear power plants	1	2	3	4	5	6
f.	Solar power plants	1	2	3	4	5	6
g.	Wind turbines	1	2	3	4	5	6
h.	Energy efficiency programs	1	2	3	4	5	6

8. On a scale of 1 to 5, where 1 means the most dependable source for generating electricity and 5 means least dependable, how would you rate: (READ EACH; ROTATE)

		Most Dependable				Least Dependable	Don't know/ Refused
a.	Coal power plants	1	2	3	4	5	6
b.	Geothermal power plants	1	2	3	4	5	6
c.	Hydro power plants	1	2	3	4	5	6
d.	Natural gas power plants	1	2	3	4	5	6
e.	Nuclear power plants	1	2	3	4	5	6
f.	Solar power plants	1	2	3	4	5	6
g.	Wind turbines	1	2	3	4	5	6
h.	Energy efficiency programs	1	2	3	4	5	6

9. (SQ) As I read each of the following statements, please tell me whether you strongly agree, agree, neither agree nor disagree, disagree somewhat or strongly disagree with it. (RANDOMIZE ORDER)

	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree	Don't know/ Refused
a[1]. We have enough reserves of coal and natural gas in the U.S. to provide for our energy needs for centuries	5	4	3	2	1	6
b[2]. Arizona has rich deposits of coal	5	4	3	2	1	6
c[1]. Utility companies have been paying too little attention to the benefits of increased energy efficiency and too much attention to developing new power sources	5	4	3	2	1	6
d[2]. Renewable energy is not worth the money it will take to develop it	5	4	3	2	1	6
e[1]. People won't reduce their electricity use without government or utility incentives	5	4	3	2	1	6
f[2]. In the future, the relative price of electricity will be higher that it is today	5	4	3	2	1	6
g[1]. When I consider electricity, the most important thing to me is the amount of my monthly bill	5	4	3	2	1	6
h[2]. State and federal regulations affect electricity prices in Arizona	5	4	3	2	1	6
i[1]. Arizona should produce all the electrical energy it needs within the state	5	4	3	2	1	6
j[2]. I would be willing to have a power generating plant built near my home if it meant more jobs in my community	5	4	3	2	1	6
k[1]. I would not object to having a wind farm located near my home	5	4	3	2	1	6
l[2]. I would not object to having solar panels installed on roofs in my neighborhood	5	4	3	2	1	6
m[1]. I would be willing to pay more for electricity so that low income households can buy electricity at a lower price than high-income households	5	4	3	2	1	6
n[2]. I would be willing to pay more for electricity from sources that consume little or no water	5	4	3	2	1	6
o[1]. We should reduce our use of coal to generate electricity to decrease pollution in Arizona	5	4	3	2	1	6
p[2]. A permanent site to store nuclear waste should be developed before constructing new nuclear power plants in Arizona	5	4	3	2	1	6
q[1]. The state of Arizona should encourage the shift to renewable energy resources by continuing to require that a certain percentage of electricity be generated from renewable sources	5	4	3	2	1	6
r[2]. I would be willing to pay more on my monthly power bill to fund rebates that lower the purchase cost for those who install solar panels at their home or business	5	4	3	2	1	6

10. On a scale of 1 to 5, where 1 is not at all concerned and 5 is extremely concerned, how concerned are you about: (RANDOMIZE ORDER)

	Not At All Concerned				Extremely Concerned	Don't know/ Refused
a. Radioactive waste from nuclear power plants?	1	2	3	4	5	6
b. Greenhouse gases produced by burning fuel to make electricity?	1	2	3	4	5	6
c. Other air pollution produced by burning fuel to make electricity?	1	2	3	4	5	6
d. Damage to river habitats from hydro electric dams?	1	2	3	4	5	6
e. Loss of water resources from hydro electric dams, solar thermal facilities, or other generating facilities?	1	2	3	4	5	6
f. The visual impact of wind farms or high voltage transmission lines on the scenery of Arizona?	1	2	3	4	5	6
g. The security of our power grid from terrorist attacks?	1	2	3	4	5	6
h. The cost of building renewable energy power plants?	1	2	3	4	5	6
i. Global warming	1	2	3	4	5	6

11. **(QUESTION 11 WAS DELETED AFTER PROGRAMMING)**

12. On average, how much would you say you pay each month for electricity?

INSERTS FOR Q13-15:

($5, $3, $1)	Less than $50...1
(15, 8, 4)	$51 to $100...2
(25, 13, 6)	$101 to $150...3
(35, 18, 9)	$151 to $200...4
(45, 23, 11)	$201 to $250...5
(55, 28, 14)	$251 to $300...6
(65, 33, 16)	$301 to $350...7
(75, 38, 19)	$351 to $400...8
(85, 43, 21)	$401 to $450...9
(95, 48, 24)	$451 to $500...10
(105, 53, 26)	$501 or more...11
(25, 13, 6)	Don't know/refused...12

(FOR QUESTIONS 13-15, RANDOMLY ASSIGN ONE OF FOUR TOPICS TO EACH OF FOUR SUB-GROUPS:
TOPIC 1 – "ASSURE A SIGNIFICANTLY CLEANER ENVIRONMENT FOR ARIZONA"
TOPIC 2 – "ASSURE AN UNINTERRUPTED SUPPLY OF ELECTRICITY FOR ARIZONA"
TOPIC 3 – "CREATE JOBS IN THE ENERGY INDUSTRY FOR ARIZONA"
TOPIC 4 – "HELP DEVELOP NEW RENEWABLE ENERGY TECHNOLOGIES")

13. (SQ) Would you be willing to pay an additional (CALCULATE DOLLAR AMOUNT FROM Q12) per month for your electrical bill now if it would (INSERT TOPIC)?

(GO TO Q15)	Yes...1
(GO TO NEXT QUESTION)	No...2
	Don't know/refused...3

14. (SQ) Would you be willing to pay an additional (CALCULATE DOLLAR AMOUNT FROM Q12) per month for your electrical bill now if it would (INSERT TOPIC)?

(GO TO Q15)	Yes...1
(GO TO NEXT QUESTION)	No...2
	Don't know/refused...3

15. (SQ) Would you be willing to pay an additional (CALCULATE DOLLAR AMOUNT FROM Q12) per month for your electrical bill now if it would (INSERT TOPIC)?

(GO TO Q16)	Yes...1
(GO TO NEXT QUESTION)	No...2
	Don't know/refused...3

16. Thinking about ways Arizona might meet its future electricity needs, please tell me how important each of the following goals is to you using a scale of 1 to 5, with 1 being not at all important and 5 being extremely important. (READ EACH; ROTATE)

		Not At All Important				Extremely Important	Don't know/ Refused
a.	Keeping electricity rates low for consumers	1	2	3	4	5	6
b.	Minimizing air pollution	1	2	3	4	5	6
c.	Using power produced in Arizona	1	2	3	4	5	6
d.	Avoiding facilities that detract from the scenic beauty of Arizona	1	2	3	4	5	6
e.	Reducing the emission of gases that may contribute to global warming	1	2	3	4	5	6
f.	Reducing radioactive wastes	1	2	3	4	5	6
g.	Creating jobs in Arizona	1	2	3	4	5	6
h.	Getting electricity from resources that will never be used up	1	2	3	4	5	6
i.	Avoiding electricity outages on hot summer days	1	2	3	4	5	6
j.	Generating your own electrical power	1	2	3	4	5	6

Now, before we finish, I need a few pieces of information about you for classification purposes only.

A. Gender (OBSERVED)

Male...1
Female...2

B. In what year were you born?

/ / / / /

C. What is the highest level of education you have had a chance to complete?

Less than high school...1
A high school diploma or GED...2
Some college...3
An undergraduate degree...4
A graduate degree...5
A doctoral degree...6
Refused (DON"T READ)...7

D. Which of the following categories best describes your total household income?

Less than $30,000...1
$30,000 to $49,999...2
$50,000 to $74,999...3
$75,000 to $99,999...4
$100,000 to $149,999...5
Over $150,000...6
Don't know/refused...7

E. Which one of the following categories best describes your ethnic origin? (READ EACH)

Caucasian...1
African-American...2
Hispanic...3
Native American...4
or Asian...5

F. Which of the following best describes your marital status?

Single...1
Married...2
Widow, divorced, separated...3

G. How many adults over 18 are in your household? /___/___/

H. How many children under the age of 18 are in your household? /___/___/

I. Did you vote in the last Presidential election, or did you choose to sit that one out?

Yes...1
No...2
Don't know/refused...3

NAME: _____

ADDRESS: _____

CITY: _____ STATE: _____ ZIP: _____

Thank you for your cooperation.

INTERVIEWER NAME: _____ #: _____
DATE: _____

Survey T2

Welcome to the Energy Forum.
Please complete this questionnaire before entering.

Affix Sticker Here ⇨

PARTICIPANT #: _____

1. Looking into the future, for each of the following resources, do you believe Arizona should increase its use of, reduce its use of or continue as we do now?

	INCREASE	CONTINUE AS NOW	REDUCE	DON'T KNOW/ REFUSED
a. Coal power plants	□1	□2	□3	□4
b. Geothermal power plants (where electricity is generated from the earth's natural underground heat)	□1	□2	□3	□4
c. Hydro power plants (where electricity is generated when water passes through a dam)	□1	□2	□3	□4
d. Natural gas power plants	□1	□2	□3	□4
e. Nuclear power plants	□1	□2	□3	□4
f. Solar power plants	□1	□2	□3	□4
g. Wind turbines	□1	□2	□3	□4
h. Energy efficiency programs	□1	□2	□3	□4

2. On a scale of 1 to 5 where 1 means least harmful to the environment and 5 means most harmful, how would you rate each of the following:

	Least Harmful				Most Harmful	Don't know/ Refused
a. Coal power plants	□1	□2	□3	□4	□5	□6
b. Geothermal power plants	□1	□2	□3	□4	□5	□6
c. Hydro power plants	□1	□2	□3	□4	□5	□6
d. Natural gas power plants	□1	□2	□3	□4	□5	□6
e. Nuclear power plants	□1	□2	□3	□4	□5	□6
f. Solar power plants	□1	□2	□3	□4	□5	□6
g. Wind turbines	□1	□2	□3	□4	□5	□6
h. Energy efficiency programs	□1	□2	□3	□4	□5	□6

3. On a scale of 1 to 5, where 1 means the power produced is least expensive and 5 means the power produced is most expensive, how would you rate each of the following:

	Least Expensive				Most Expensive	Don't know/ Refused
a. Coal power plants	□1	□2	□3	□4	□5	□6
b. Geothermal power plants	□1	□2	□3	□4	□5	□6
c. Hydro power plants	□1	□2	□3	□4	□5	□6
d. Natural gas power plants	□1	□2	□3	□4	□5	□6
e. Nuclear power plants	□1	□2	□3	□4	□5	□6
f. Solar power plants	□1	□2	□3	□4	□5	□6
g. Wind turbines	□1	□2	□3	□4	□5	□6
h. Energy efficiency programs	□1	□2	□3	□4	□5	□6

4. On a scale of 1 to 5, where 1 means the most dependable source for generating electricity and 5 means least dependable, how would you rate:

	Most Dependable				Least Dependable	Don't know/ Refused
a. Coal power plants	□1	□2	□3	□4	□5	□6
b. Geothermal power plants	□1	□2	□3	□4	□5	□6
c. Hydro power plants	□1	□2	□3	□4	□5	□6
d. Natural gas power plants	□1	□2	□3	□4	□5	□6
e. Nuclear power plants	□1	□2	□3	□4	□5	□6
f. Solar power plants	□1	□2	□3	□4	□5	□6
g. Wind turbines	□1	□2	□3	□4	□5	□6
h. Energy efficiency programs	□1	□2	□3	□4	□5	□6

5. Thinking about ways Arizona might meet its future electricity needs, please tell me how important each of the following goals is to you using a scale of 1 to 5, with 1 being not at all important and 5 being extremely important.

	Not At All Important				Extremely Important	Don't know/ Refused
a. Keeping electricity rates low for consumers	☐1	☐2	☐3	☐4	☐5	☐6
b. Minimizing air pollution	☐1	☐2	☐3	☐4	☐5	☐6
c. Using power produced in Arizona	☐1	☐2	☐3	☐4	☐5	☐6
d. Avoiding facilities that detract from the scenic beauty of Arizona	☐1	☐2	☐3	☐4	☐5	☐6
e. Reducing the emission of gases that may contribute to global warming	☐1	☐2	☐3	☐4	☐5	☐6
f. Reducing radioactive wastes	☐1	☐2	☐3	☐4	☐5	☐6
g. Creating jobs in Arizona	☐1	☐2	☐3	☐4	☐5	☐6
h. Getting electricity from resources that will never be used up	☐1	☐2	☐3	☐4	☐5	☐6
i. Avoiding electricity outages on hot summer days	☐1	☐2	☐3	☐4	☐5	☐6
j. Generating your own electrical power	☐1	☐2	☐3	☐4	☐5	☐6

6. Some people think that because electricity is a basic necessity, those with low incomes should be charged a lower rate for the power they use. Other people think that because electricity use is based on personal choices, all utility customers should be charged at the same rate for the power they use. Using the 7-point scale below, where would you place your own point of view between these two views?

Those With Low Incomes Should Be Charged A Lower Rate						All Utility Customers Should Be Charged The Same Rate
1	2	3	4	5	6	7

7. How many more dollars per month would you be willing to pay to help offset the cost of electricity for low income residents? (Enter a number of dollars; if you wouldn't be willing to pay more for this, just enter 0.)

$ _____

8. Please rate your satisfaction with the Briefing Book that was sent to you in advance of this Energy Forum on each of the following, using a 5-point scale where 5 means you are very satisfied and one means you are very dissatisfied:

	Very Dissatisfied				Very Satisfied
a. Readability	☐1	☐2	☐3	☐4	☐5
b. Informative	☐1	☐2	☐3	☐4	☐5
c. Easy to find information	☐1	☐2	☐3	☐4	☐5
d. Clear	☐1	☐2	☐3	☐4	☐5
e. Of value	☐1	☐2	☐3	☐4	☐5
f. Your overall reaction to the booklet	☐1	☐2	☐3	☐4	☐5

9. How much of the Energy Forum Briefing Book did you read? Would you say:

All of it...☐1
More than half of it...☐2
About half of it...☐3
Less than half of it...☐4
None of it...☐5

10. How much time did you spend reading the Energy Forum Briefing Book?

Less than one hour...☐1
1 - 3 hours...☐2
More than 3 hours...☐3
I did not read it...☐4

11. Did others in your household read the Briefing Book?

Yes...☐[1]
No...☐[2]

12. Did you view the DVD that was sent to you?

Yes...☐[1]
No...☐[2]

13. Did you visit the Energy Forum web site?

Yes...☐[1]
No...☐[2]

14. After being invited to the Energy Forum, did you search online or in reference books about energy?

Yes...☐[1]
No...☐[2]

15. Did you talk with family members, friends or co-workers about being invited to participate in the Energy Forum today? Check all that apply.

Family...☐[1]
Friends...☐[2]
Co-workers...☐[3]
None of these...☐[4]

16. Did you talk with family members, friends or co-workers about the Energy Forum Briefing Book? Check all that apply.

Family...☐[1]
Friends...☐[2]
Co-workers...☐[3]
None of these...☐[4]

17. How would you rate your knowledge level of electric energy sources? Would you say:

Know a lot...☐[1]
Know some...☐[2]
Know only a little...☐[3]
Know nothing at all...☐[4]

18. Would you say receiving the Energy Forum Briefing Book has changed your opinion about the best mix of energy sources for Arizona?

A lot...☐[1]
A little...☐[2]
Hasn't changed...☐[3]

Survey T3

Thank you for participating in the Energy Forum today.
Please complete this questionnaire and leave it at the Information Desk.

Affix Sticker Here ⇨

1. Looking into the future, for each of the following resources, do you believe Arizona should increase its use of, reduce its use of or continue as we do now?

	Increase	Continue As Now	Reduce	Don't Know/ Refused
a. Coal power plants	☐1	☐2	☐3	☐4
b. Geothermal power plants (where electricity is generated from the earth's natural underground heat)	☐1	☐2	☐3	☐4
c. Hydro power plants (where electricity is generated when water passes through a dam)	☐1	☐2	☐3	☐4
d. Natural gas power plants	☐1	☐2	☐3	☐4
e. Nuclear power plants	☐1	☐2	☐3	☐4
f. Solar power plants	☐1	☐2	☐3	☐4
g. Wind turbines	☐1	☐2	☐3	☐4

2. On a scale of 1 to 5 where 1 means least harmful to the environment and 5 means most harmful, how would you rate each of the following:

	Least Harmful				Most Harmful	Don't know/ Refused
a. Coal power plants	☐1	☐2	☐3	☐4	☐5	☐6
b. Geothermal power plants	☐1	☐2	☐3	☐4	☐5	☐6
c. Hydro power plants	☐1	☐2	☐3	☐4	☐5	☐6
d. Natural gas power plants	☐1	☐2	☐3	☐4	☐5	☐6
e. Nuclear power plants	☐1	☐2	☐3	☐4	☐5	☐6
f. Solar power plants	☐1	☐2	☐3	☐4	☐5	☐6
g. Wind turbines	☐1	☐2	☐3	☐4	☐5	☐6
h. Energy efficiency programs	☐1	☐2	☐3	☐4	☐5	☐6

3. On a scale of 1 to 5, where 1 means the power produced is least expensive and 5 means the power produced is most expensive, how would you rate each of the following:

	Least Expensive				Most Expensive	Don't know/ Refused
a. Coal power plants	☐1	☐2	☐3	☐4	☐5	☐6
b. Geothermal power plants	☐1	☐2	☐3	☐4	☐5	☐6
c. Hydro power plants	☐1	☐2	☐3	☐4	☐5	☐6
d. Natural gas power plants	☐1	☐2	☐3	☐4	☐5	☐6
e. Nuclear power plants	☐1	☐2	☐3	☐4	☐5	☐6
f. Solar power plants	☐1	☐2	☐3	☐4	☐5	☐6
g. Wind turbines	☐1	☐2	☐3	☐4	☐5	☐6
h. Energy efficiency programs	☐1	☐2	☐3	☐4	☐5	☐6

4. On a scale of 1 to 5, where 1 means the most dependable source for generating electricity and 5 means least dependable, how would you rate:

	Most Dependable				Least Dependable	Don't know/ Refused
a. Coal power plants	☐1	☐2	☐3	☐4	☐5	☐6
b. Geothermal power plants	☐1	☐2	☐3	☐4	☐5	☐6
c. Hydro power plants	☐1	☐2	☐3	☐4	☐5	☐6
d. Natural gas power plants	☐1	☐2	☐3	☐4	☐5	☐6
e. Nuclear power plants	☐1	☐2	☐3	☐4	☐5	☐6
f. Solar power plants	☐1	☐2	☐3	☐4	☐5	☐6
g. Wind turbines	☐1	☐2	☐3	☐4	☐5	☐6
h. Energy efficiency programs	☐1	☐2	☐3	☐4	☐5	☐6

5. As I read each of the following statements, please tell me whether you strongly agree, agree, neither agree nor disagree, disagree somewhat or strongly disagree with it.	Strongly Agree	Agree	Neither	Disagree	Strongly Disagree	Don't know/ Refused
a. We have enough reserves of coal and natural gas in the U.S. to provide for our energy needs for centuries	☐5	☐4	☐3	☐2	☐1	☐6
b. Arizona has rich deposits of coal	☐5	☐4	☐3	☐2	☐1	☐6
c. Utility companies have been paying too little attention to the benefits of increased energy efficiency and too much attention to developing new power sources	☐5	☐4	☐3	☐2	☐1	☐6
d. Renewable energy is not worth the money it will take to develop it	☐5	☐4	☐3	☐2	☐1	☐6
e. People won't reduce their electricity use without government or utility incentives	☐5	☐4	☐3	☐2	☐1	☐6
f. In the future, the relative price of electricity will be higher that it is today	☐5	☐4	☐3	☐2	☐1	☐6
g. When I consider electricity, the most important thing to me is the amount of my monthly bill	☐5	☐4	☐3	☐2	☐1	☐6
h. State and federal regulations affect electricity prices in Arizona	☐5	☐4	☐3	☐2	☐1	☐6
i. Arizona should produce all the electrical energy it needs within the state	☐5	☐4	☐3	☐2	☐1	☐6
j. I would be willing to have a power generating plant built near my home if it meant more jobs in my community	☐5	☐4	☐3	☐2	☐1	☐6
k. I would not object to having a wind farm located near my home	☐5	☐4	☐3	☐2	☐1	☐6
l. I would not object to having solar panels installed on roofs in my neighborhood	☐5	☐4	☐3	☐2	☐1	☐6
m. I would be willing to pay more for electricity so that low income households can buy electricity at a lower price than high-income households	☐5	☐4	☐3	☐2	☐1	☐6
n. I would be willing to pay more for electricity from sources that consume little or no water	☐5	☐4	☐3	☐2	☐1	☐6
o. We should reduce our use of coal to generate electricity to decrease pollution in Arizona	☐5	☐4	☐3	☐2	☐1	☐6
p. A permanent site to store nuclear waste should be developed before constructing new nuclear power plants in Arizona	☐5	☐4	☐3	☐2	☐1	☐6
q. The state of Arizona should encourage the shift to renewable energy resources by continuing to require that a certain percentage of electricity be generated from renewable sources	☐5	☐4	☐3	☐2	☐1	☐6
r. I would be willing to pay more on my monthly power bill to fund rebates that lower the purchase cost for those who install solar panels at their home or business	☐5	☐4	☐3	☐2	☐1	☐6

6. On a scale of 1 to 5, where 1 is not at all concerned and 5 is extremely concerned, how concerned are you about:

	Not At All Concerned				Extremely Concerned	Don't know/ Refused
a. Radioactive waste from nuclear power plants?	☐1	☐2	☐3	☐4	☐5	☐6
b. Greenhouse gases produced by burning fuel to make electricity?	☐1	☐2	☐3	☐4	☐5	☐6
c. Other air pollution produced by burning fuel to make electricity?	☐1	☐2	☐3	☐4	☐5	☐6
d. Damage to river habitats from hydro electric dams?	☐1	☐2	☐3	☐4	☐5	☐6
e. Loss of water resources from hydro electric dams, solar thermal facilities, or other generating facilities?	☐1	☐2	☐3	☐4	☐5	☐6
f. The visual impact of wind farms or high voltage transmission lines on the scenery of Arizona?	☐1	☐2	☐3	☐4	☐5	☐6
g. The security of our power grid from terrorist attacks?	☐1	☐2	☐3	☐4	☐5	☐6
h. The cost of building renewable energy power plants?	☐1	☐2	☐3	☐4	☐5	☐6
i. Global warming?	☐1	☐2	☐3	☐4	☐5	☐6

7. Thinking about ways Arizona might meet its future electricity needs, please tell me how important each of the following goals is to you using a scale of 1 to 5, with 1 being not at all important and 5 being extremely important.

	Not At All Important				Extremely Important	Don't know/ Refused
a. Keeping electricity rates low for consumers	☐1	☐2	☐3	☐4	☐5	☐6
b. Minimizing air pollution	☐1	☐2	☐3	☐4	☐5	☐6
c. Using power produced in Arizona	☐1	☐2	☐3	☐4	☐5	☐6
d. Avoiding facilities that detract from the scenic beauty of Arizona	☐1	☐2	☐3	☐4	☐5	☐6
e. Reducing the emission of gases that may contribute to global warming	☐1	☐2	☐3	☐4	☐5	☐6
f. Reducing radioactive wastes	☐1	☐2	☐3	☐4	☐5	☐6
g. Creating jobs in Arizona	☐1	☐2	☐3	☐4	☐5	☐6
h. Getting electricity from resources that will never be used up	☐1	☐2	☐3	☐4	☐5	☐6
i. Avoiding electricity outages on hot summer days	☐1	☐2	☐3	☐4	☐5	☐6
j. Generating your own electrical power	☐1	☐2	☐3	☐4	☐5	☐6

8. Some people think that because electricity is a basic necessity, those with low incomes should be charged a lower rate for the power they use. Other people think that because electricity use is based on personal choices, all utility customers should be charged at the same rate for the power they use. Using the 7-point scale below, where would you place your own point of view between these two views?

Those With Low Incomes Should Be Charged A Lower Rate						All Utility Customers Should Be Charged The Same Rate
1	2	3	4	5	6	7

9. How many more dollars per month would you be willing to pay to help offset the cost of electricity for low income residents? (Enter a number of dollars; if you wouldn't be willing to pay more for this, just enter 0.)

$_____

10. How well did the reading material you received prepare you for today's discussions, using a 5-point scale where 5 means it prepared you very well and one mans it did not prepare you for today's discussions?

Did not prepare me				Prepared me very well
☐[1]	☐[2]	☐[3]	☐[4]	☐[5]

THE ENERGY FORUM

11. Please rate your level of agreement with each of the following statements, using a 5-point scale where 5 means you completely agree and one means you completely disagree.

	Completely Disagree				Completely Agree
a. My time was well spent	☐[1]	☐[2]	☐[3]	☐[4]	☐[5]
b. The panel discussions were valuable to me	☐[1]	☐[2]	☐[3]	☐[4]	☐[5]
c. The small group sessions were valuable to me	☐[1]	☐[2]	☐[3]	☐[4]	☐[5]
d. The Energy Forum provided us with enough time to properly address the issues	☐[1]	☐[2]	☐[3]	☐[4]	☐[5]
e. The compensation we are being paid is fair	☐[1]	☐[2]	☐[3]	☐[4]	☐[5]

12. Please add any comments you wish:

_____

_____

_____

_____

_____

Survey T4

BEHAVIOR RESEARCH CENTER, INC.
45 East Monterey Way
Phoenix, AZ 85012
(602) 258-4554

MORRISON INSTITUTE FOR PUBLIC POLICY
APS
T-4

JOB ID 2010062

Hello, my name is _____ and I'm with Behavior Research Center, following up on the Energy Forum (NAME FROM SAMPLE) attended on December 4. Is (HE/SHE) available? (IF NO; SCHEDULE CALLBACK)

CALLBACK INFO: _____

(WHEN ON THE LINE; REINTRODUCE YOURSELF) Thank you for participating in the Energy Forum. As you may recall, you were informed during that forum that we would be calling you again for the final step in this project.

1. In Arizona we currently generate electricity from several different resources. To the best of your knowledge, from which of the following does most of our electricity come from? (READ LIST, ROTATE AND RECORD ONLY ONE ANSWER)

Coal power plants...1
Geothermal power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated from the earth's natural underground heat)...2
Hydro power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated when water passes through a dam)...3
Natural gas power plants...4
Nuclear power plants...5
Solar power plants...6
Wind turbines...7
(DO NOT READ) Don't know/refused...8

2. And, which one of these resources do you believe is the second most used for generating electricity? (ELIMINATE CHOICE FROM Q1; READ LIST)

Coal power plants...1
Geothermal power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated from the earth's natural underground heat)...2
Hydro power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated when water passes through a dam)...3
Natural gas power plants...4
Nuclear power plants...5
Solar power plants...6
Wind turbines...7
(DO NOT READ) Don't know/refused...8

3. Which two of the following resources do you believe are least used for generating electricity in Arizona (ELIMINATE ANSWERS TO Q1 AND Q2; READ LIST)

Coal power plants...1
Geothermal power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated from the earth's natural underground heat)...2
Hydro power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated when water passes through a dam)...3
Natural gas power plants...4
Nuclear power plants...5
Solar power plants...6
Wind turbines...7
(DO NOT READ) Don't know/refused...8

4. Arizona electric utilities offer incentives to consumers to encourage use of energy efficient appliances or equipment. Like other resource investments, all utility customers pay for those incentives. In the future, do you believe Arizona should increase its use of these energy efficiency incentive programs, reduce its use of energy efficiency incentive programs, or continue as we do now?

Increase...1
Continue as now...2
Reduce...3
Don't know/refused...4

5. Looking into the future, for each of the following resources, do you believe Arizona should increase its use of, reduce its use of or continue as we do now? (READ EACH; ROTATE)

		Increase	Continue As Now	Reduce	Don't Know/ Refused
a.	Coal power plants	1	2	3	4
b.	Geothermal power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated from the earth's natural underground heat)	1	2	3	4
c.	Hydro power plants (INTERVIEWER EXPLAIN IF NEEDED: where electricity is generated when water passes through a dam)	1	2	3	4
d.	Natural gas power plants	1	2	3	4
e.	Nuclear power plants	1	2	3	4
f.	Solar power plants	1	2	3	4
g.	Wind turbines	1	2	3	4

6. On a scale of 1 to 5 where 1 means least harmful to the environment and 5 means most harmful, how would you rate each of the following: (READ EACH; ROTATE)

		Least Harmful				Most Harmful	Don't know/ Refused
a.	Coal power plants	1	2	3	4	5	6
b.	Geothermal power plants	1	2	3	4	5	6
c.	Hydro power plants	1	2	3	4	5	6
d.	Natural gas power plants	1	2	3	4	5	6
e.	Nuclear power plants	1	2	3	4	5	6
f.	Solar power plants	1	2	3	4	5	6
g.	Wind turbines	1	2	3	4	5	6
h.	Energy efficiency programs	1	2	3	4	5	6

7. On a scale of 1 to 5, where 1 means least expensive and 5 means most expensive, how would you rate each of the following: (READ EACH; ROTATE)

		Least Expensive				Most Expensive	Don't know/ Refused
a.	Coal power plants	1	2	3	4	5	6
b.	Geothermal power plants	1	2	3	4	5	6
c.	Hydro power plants	1	2	3	4	5	6
d.	Natural gas power plants	1	2	3	4	5	6
e.	Nuclear power plants	1	2	3	4	5	6
f.	Solar power plants	1	2	3	4	5	6
g.	Wind turbines	1	2	3	4	5	6
h.	Energy efficiency programs	1	2	3	4	5	6

8. On a scale of 1 to 5, where 1 means the most dependable source for generating electricity and 5 means least dependable, how would you rate: (READ EACH; ROTATE)

		Most Dependable				Least Dependable	Don't know/ Refused
a.	Coal power plants	1	2	3	4	5	6
b.	Geothermal power plants	1	2	3	4	5	6
c.	Hydro power plants	1	2	3	4	5	6
d.	Natural gas power plants	1	2	3	4	5	6
e.	Nuclear power plants	1	2	3	4	5	6
f.	Solar power plants	1	2	3	4	5	6
g.	Wind turbines	1	2	3	4	5	6
h.	Energy efficiency programs	1	2	3	4	5	6

9. As I read each of the following statements, please tell me whether you strongly agree, agree, neither agree nor disagree, disagree somewhat or strongly disagree with it. (RANDOMIZE ORDER)

		Strongly Agree	Agree	Neither	Disagree	Strongly Disagree	Don't know/ Refused
a.	We have enough reserves of coal and natural gas in the U.S. to provide for our energy needs for centuries	5	4	3	2	1	6
b.	Arizona has rich deposits of coal	5	4	3	2	1	6
c.	Utility companies have been paying too little attention to the benefits of increased energy efficiency and too much attention to developing new power sources	5	4	3	2	1	6
d.	Renewable energy is not worth the money it will take to develop it	5	4	3	2	1	6
e.	People won't reduce their electricity use without government or utility incentives	5	4	3	2	1	6
f.	In the future, the relative price of electricity will be higher that it is today	5	4	3	2	1	6
g.	When I consider electricity, the most important thing to me is the amount of my monthly bill	5	4	3	2	1	6
h.	State and federal regulations affect electricity prices in Arizona	5	4	3	2	1	6
i.	Arizona should produce all the electrical energy it needs within the state	5	4	3	2	1	6
j.	I would be willing to have a power generating plant built near my home if it meant more jobs in my community	5	4	3	2	1	6
k.	I would not object to having a wind farm located near my home	5	4	3	2	1	6
l.	I would not object to having solar panels installed on roofs in my neighborhood	5	4	3	2	1	6
m.	I would be willing to pay more for electricity so that low income households can buy electricity at a lower price than high-income households	5	4	3	2	1	6
n.	I would be willing to pay more for electricity from sources that consume little or no water	5	4	3	2	1	6
o.	We should reduce our use of coal to generate electricity to decrease pollution in Arizona	5	4	3	2	1	6
p.	A permanent site to store nuclear waste should be developed before constructing new nuclear power plants in Arizona	5	4	3	2	1	6
q.	The state of Arizona should encourage the shift to renewable energy resources by continuing to require that a certain percentage of electricity be generated from renewable sources	5	4	3	2	1	6
r.	I would be willing to pay more on my monthly power bill to fund rebates that lower the purchase cost for those who install solar panels at their home or business	5	4	3	2	1	6

10. On a scale of 1 to 5, where 1 is not at all concerned and 5 is extremely concerned, how concerned are you about: (RANDOMIZE ORDER)

		Not At All Concerned				Extremely Concerned	Don't know/ Refused
a.	Radioactive waste from nuclear power plants?	1	2	3	4	5	6
b.	Greenhouse gases produced by burning fuel to make electricity?	1	2	3	4	5	6
c.	Other air pollution produced by burning fuel to make electricity?	1	2	3	4	5	6
d.	Damage to river habitats from hydro electric dams?	1	2	3	4	5	6
e.	Loss of water resources from hydro electric dams, solar thermal facilities, or other generating facilities?	1	2	3	4	5	6
f.	The visual impact of wind farms or high voltage transmission lines on the scenery of Arizona?	1	2	3	4	5	6
g.	The security of our power grid from terrorist attacks?	1	2	3	4	5	6
h.	The cost of building renewable energy power plants?	1	2	3	4	5	6
i.	Global warming	1	2	3	4	5	6

11. **(QUESTION 11 DELETED)**

12. (DO NOT READ) On average, how much would you say you pay each month for electricity? (IMPORT ANSWER FROM T-1)

INSERTS FOR Q13-15:

($5, $3, $1)	Less than $50...1
(15, 8, 4)	$51 to $100...2
(25, 13, 6)	$101 to $150...3
(35, 18, 9)	$151 to $200...4
(45, 23, 11)	$201 to $250...5
(55, 28, 14)	$251 to $300...6
(65, 33, 16)	$301 to $350...7
(75, 38, 19)	$351 to $400...8
(85, 43, 21)	$401 to $450...9
(95, 48, 24)	$451 to $500...10
(105, 53, 26)	$501 or more...11
(25, 13, 6)	Don't know/refused...12

(FOR QUESTIONS 13-15, ASSIGN THE TOPIC ADDRESSED IN T-1:
TOPIC 1 – "ASSURE A SIGNIFICANTLY CLEANER ENVIRONMENT FOR ARIZONA"
TOPIC 2 – "ASSURE AN UNINTERRUPTED SUPPLY OF ELECTRICITY FOR ARIZONA"
TOPIC 3 – "CREATE JOBS IN THE ENERGY INDUSTRY FOR ARIZONA"
TOPIC 4 – "HELP DEVELOP NEW RENEWABLE ENERGY TECHNOLOGIES")

13. (SQ) Would you be willing to pay an additional (CALCULATE DOLLAR AMOUNT FROM Q12) per month for your electrical bill now if it would (INSERT TOPIC)?

(GO TO Q15)	Yes...1
(GO TO NEXT QUESTION)	No...2
	Don't know/refused...3

14. (SQ) Would you be willing to pay an additional (CALCULATE DOLLAR AMOUNT FROM Q12) per month for your electrical bill now if it would (INSERT TOPIC)?

(GO TO Q15)	Yes...1
(GO TO NEXT QUESTION)	No...2
	Don't know/refused...3

15. (SQ) Would you be willing to pay an additional (CALCULATE DOLLAR AMOUNT FROM Q12) per month for your electrical bill now if it would (INSERT TOPIC)?

(GO TO Q16)	Yes...1
(GO TO NEXT QUESTION)	No...2
	Don't know/refused...3

16. Thinking about ways Arizona might meet its future electricity needs, please tell me how important each of the following goals is to you using a scale of 1 to 5, with 1 being not at all important and 5 being extremely important. (READ EACH; ROTATE)

		Not At All Important				Extremely Important	Don't know/ Refused
a.	Keeping electricity rates low for consumers	1	2	3	4	5	6
b.	Minimizing air pollution	1	2	3	4	5	6
c.	Using power produced in Arizona	1	2	3	4	5	6
d.	Avoiding facilities that detract from the scenic beauty of Arizona	1	2	3	4	5	6
e.	Reducing the emission of gases that may contribute to global warming	1	2	3	4	5	6
f.	Reducing radioactive wastes	1	2	3	4	5	6
g.	Creating jobs in Arizona	1	2	3	4	5	6
h.	Getting electricity from resources that will never be used up	1	2	3	4	5	6
i.	Avoiding electricity outages on hot summer days	1	2	3	4	5	6
j.	Generating your own electrical power	1	2	3	4	5	6

17. Thinking back on your experience with the Energy Forum, how would you rate each of the following in terms of how much it influenced your opinion about whether to increase or decrease certain energy resources? Use a five-point scale where 5 means it was very influential and 1 means it had no influence on your thinking (ROTATE A-E; ASK F LAST).

		No influence				Very influential	Don't know/ Refused
a.	Reviewing the printed booklet before the Energy Forum on December 4th	1	2	3	4	5	6
b.	Listening to the expert panelists at the Energy Forum	1	2	3	4	5	6
c.	Participating in the small group discussions at the Energy Forum	1	2	3	4	5	6
d.	Reviewing the Energy Forum web site, mienergyforum.asu.edu	1	2	3	4	5	6
e.	Speaking with friends, family or others before or after the Energy Forum	1	2	3	4	5	6
f.	Your own knowledge, experience or values	1	2	3	4	5	6

PARTICIPANT ID: _____

NAME: _____

ADDRESS: _____

CITY: _____ STATE: _____ ZIP: _____

Thank you for your cooperation.

INTERVIEWER NAME: _____ #: _____
DATE: _____

APPENDIX B: PARTICIPANT DEMOGRAPHICS AND METHODS

Energy Forum Attendee Demographics	
Gender	
Male	43.5%
Female	56.5%
Age	
18-24	0.0%
25-34	9.4%
35-44	11.7%
45-54	21.1%
55-64	26.1%
65+	31.7%
Location	
Other Counties	22.8%
Maricopa	77.2%
Highest Level of Education	
Some H.S./H.S. diploma	20.2%
Some College/Bachelor's	36.6%
Advanced Degree	43.2%
Household Income	
Less than $30,000	19.5%
$30,000 - $49,999	25.8%
$50,000 - $74,999	23.3%
$75,000 - $100,000	10.1%
$100,000+	21.4%
Ethnicity	
Caucasian	85.3%
African American	1.1%
Hispanic	8.2%
Native American	2.2%
Asian	3.3%
Marital Status	
Single	14.8%
Married	64.5%
Widowed/Divorced	20.8%

Table B-1.

The Informed Perception Process

This study uses an Informed Perception methodology which moves study participants through an educational process to determine whether exposure to specific, unbiased information affects attitudes and opinions about a particular topic. For this project, participants were exposed to an energy resource booklet and an energy forum which featured panel discussions from energy experts and small moderated group discussions. The Informed Perception process is designed to provide public input that is both representative of a particular target audience and informed by balanced, accurate information.

Sampling and Recruitment

Sampling and recruitment for this project was conducted by Behavioral Research Center (BRC), an independent market and public research firm headquartered in Phoenix, Arizona. BRC recruited a representative sample of APS customers from across Arizona through Random Digit Dialing and administered four (4) surveys to study participants at four different points in time (T1, T2, T3 and T4). The survey instruments were designed by Morrison Institute with content input from a 26-member Collaboration Committee representing a diverse cross-section of Arizona energy experts and technical input from BRC. The surveys are included in Appendix A.

Time 1 (T1) Survey and Energy Forum Recruiting Sample Disposition

Total sample loaded	**32,500**
Total non-completed interviews	**31,417**
• No answer	10,659
• Answering machine	6,149
• Refusals	4,362
• Business/Government phone	3,455
• Fax number	2,827
• Blocked call	2,407
• Phone busy	792
• Respondent never available	766
Total completed interviews	**1,083**
• Time 1 (T1)	800
• Time 1 (T1)+ Energy Forum Recruitment	283

*T1 sampling and Energy Forum recruitment occurred from October 13, 2010 to November 28, 2010.
Table B-2.

Surveys T2 and T3 were administered at the Energy Forum on December 4, 2010 to the 183 participants who attended.

Time 4 (T4) Survey Sample Disposition

Total sample loaded (Energy Forum Participants)	**183**
Total non-completed interviews	**24**
• No answer (repeated attempts)	4
• Answering machine (repeated attempts)	5
• Refusals	7
• Disconnected phone	5
• Respondent never available	3
Total completed interviews	**159**

*T4 sampling occurred from January 4, 2011 to January 24, 2011.
Table B-3.

The Briefing Document

The energy resource booklet was created by Morrison Institute for Public Policy with input from a 24-member Collaborative Committee representing a diverse cross-section of Arizona energy experts. The booklet was designed to serve as balanced and unbiased educational material provided to the Energy Forum participants about the eight energy sources- coal, natural gas, nuclear, solar, wind, hydro, geothermal, and energy efficiency- being considered to meet Arizona's energy needs.

Qualitative Analysis

Moderator notes from the three, one hour participant breakout sessions at the Energy Forum were analyzed to determine trends and themes that emerged about energy planning and resource options for APS. Additionally, notable quotes and specific recommendations made by the participants were captured in the analysis and used to bolster the quantitative results presented in this report. The qualitative analysis is particularly useful in understanding the impact of the information presented at the Energy Forum by the expert panelists and the moderated small group discussions. The qualitative analysis may also elucidate the measurable shifts in opinion between the T2 and T3 surveys.

Quantitative Analysis

Comparisons across time points

Several assertions in this report consider the differences between participants' opinions and attitudes across time, such as before and after the event. The differences noted as statistically significant in this report are based on paired t-tests that compare the average difference in individual responses to the sampling error of those differences. Specifically, if y_{it} is the answer for individual i at time t and y_{it+1} is the answer to the same question but at a different time point t+1, then we can:

Calculate the difference d_i for each individual

$$d_i = y_{it+1} - y_{it}$$

Find two important quantities, the average difference across all individuals

$$\bar{d} = \sum d_i / N$$

Determine the standard deviation of those differences where N is the number of cases.

$$s_d = \sqrt{\sum \left(d_i - \bar{d}\right)^2 / N - 1}$$

With these two quantities in hand, we are able to calculate the paired t-test of difference for matched pairs which is a statistic with n-1 degrees of freedom. This statistic is then evaluated against the t-distribution and if its probability is less than or equal to 0.05, then we consider the difference to be statistically significant.

$$t = \left(\bar{d}\sqrt{N}\right) / s_d$$

For proportions, we used a two-sample test of proportions. If p_t is the proportion of y = yes (coded as 1) at time t and p_{t+1} is the proportion at time t+1, then our z-statistic was then

$$z = \left(p_{t+1} - p_t\right) \Big/ \sqrt{\left(\frac{\sum y_{it+1} + \sum y_{it}}{2N}\right) \times \left(1 - \frac{\sum y_{it+1} + \sum y_{it}}{2N}\right) \times (2/N)}$$

This statistic is then evaluated against the normal distribution and if its probability is less than or equal to 0.05, then we consider the difference to be statistically significant.

The cost analysis employed two types of regression analysis. To calculate the adjusted averages, we used simple linear regression to predict dollar values that respondents agreed to with income, amount of bill, and age grand mean centered. This made the intercept represent a typical APS customer's average dollar amount they were willing to pay for each individual program.

The other type of regression we used was an ordered logistic regression. This generalized linear model makes the assumption that the observed categories (0%, 5%, 10% and 20% of respondents' bills) represented responses (although not evenly spaced) from a latent continuous trait. These models helped us ascertain which predictors were associated with categorical responses.

APPENDIX C: PROCESS FLOW CHART

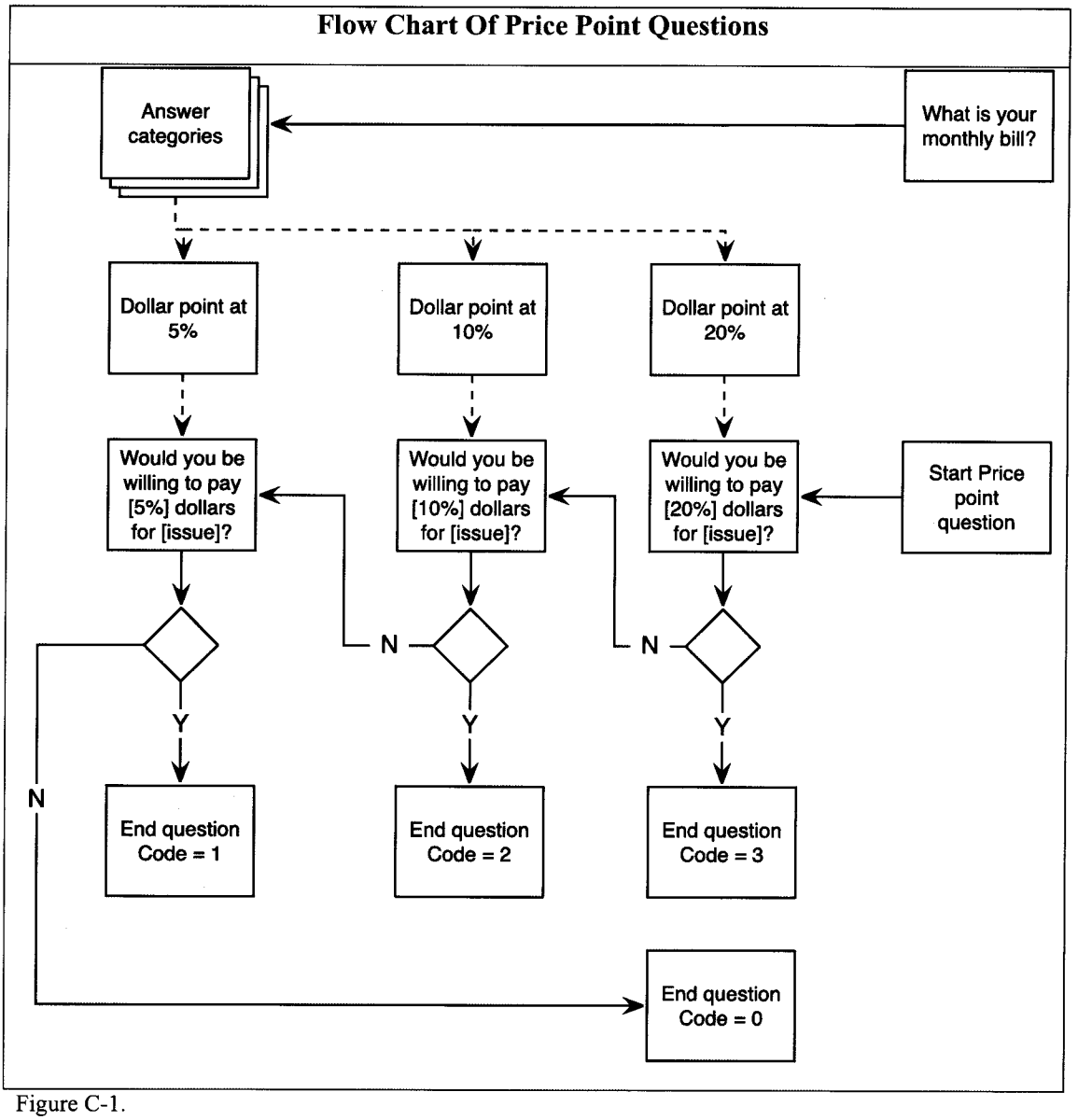


Figure C-1.

APPENIDIX D: PRICE POINT FREQUENCY TABLES

Distribution of responses to "Would you be willing to pay an additional X% per month for your

electrical bill now if it would assure a significantly cleaner environment for Arizona?"

Price point	Frequency	Percent
Nothing	31	23.7
5 % of bill	13	9.9
10 % of bill	17	13
20 % of bill	**70**	**53.4**
Total	131	00.0

Table D-1.

Distribution of responses to "Would you be willing to pay an additional X% per month for your electrical bill now if it would assure an uninterrupted supply of electricity for Arizona?"

Price point	Frequency	Percent
Nothing	**54**	**42.5**
5 % of bill	16	12.6
10 % of bill	17	13.4
20 % of bill	40	31.9
Total	127	100.0

Table D-2.

Distribution of responses to "Would you be willing to pay an additional X% per month for your electrical bill now if it would create jobs in the energy industry for Arizona?"

Price point	Frequency	Percent
Nothing	**47**	**34.8**
5 % of bill	19	14.1
10 % of bill	20	14.8
20 % of bill	**49**	**36.3**
Total	135	100.0

Table D-3.

Distribution of responses to "Would you be willing to pay an additional X% per month for your electrical bill now if it would help develop new renewable energy technologies?"

Price point	Frequency	Percent
Nothing	50	31.3
5 % of bill	15	9.3
10 % of bill	27	16.9
20 % of bill	**68**	**42.5**
Total	160	100.0

Table D-4.

APPENIX E: ORDERED LOGISTIC MODEL

This analysis assessed which factors played a role in respondent's answers and to estimate the cumulative percent for a typical APS customer. To do this, we fit ordered logistic models that predicted which answer category individuals fell into, and what factors were associated with moving from a lower price point to a higher one. Ordered logistic models also provided thresholds for each category, allowing one to estimate the cumulative percent distribution for the "reference person" who was 0 on all predictors. Since we mean-centered age, income and, the monthly bill[24], our reference person was a person who lived in Maricopa County, did not feel that the monthly bill was an important factor to consider when meeting Arizona energy needs, was of average age with an average income and average monthly bill. The following tables report the output from this model related to the four issue areas. The bolded lines within the tables are statistically significant.

Table E-2. Ordinal logistic model predicting categorical responses to "Would you be willing to pay an additional X% per month for your electrical bill now if it would assure a significantly cleaner environment for Arizona?" (N = 131 respondents from exogenous sample)

Predictor	Coefficient	Odds Ratio	p-value
Income ($10k)-Mean	0.00	1.00	0.504
Monthly Bill ($100) - Mean	**-0.48**	**0.62**	**0.024**
Age/10 - Mean	-0.16	0.85	0.184
Keeping rates low is not important	**1.06**	**2.88**	**0.031**
Non-Maricopa County	-0.11	0.90	0.795

Estimated Thresholds*		
Level	**Coefficient**	**Cumulative Percent**
Nothing	-1.06	26%
5 % of bill	-0.54	37%
10 % of bill	0.06	51%
20 % of bill	.	100%

*Note: thresholds assume average income, average monthly bill, average age, where keeping rates low is important, and living in Maricopa County

[24] While income and the monthly bill were originally coded as categories, these variables were recoded so that the midpoint of each category replaced the coded value. This allows us to enter these variables in as continuous dollar amounts.

Table E-3. Ordinal logistic model predicting categorical responses to "Would you be willing to pay an additional X% per month for your electrical bill now if it would assure an uninterrupted supply of electricity for Arizona?" (N = 125 respondents from exogenous sample)

Predictor	Coefficient	Odds Ratio	p-value
Income ($10k)-Mean	0.01	1.01	0.093
Monthly Bill ($100) - Mean	**-0.70**	**0.49**	**0.002**
Age/10 - Mean	-0.15	0.86	0.180
Keeping rates low is not important	**1.11**	**3.04**	**0.010**
Non-Maricopa County	-0.80	0.45	0.058

Estimated Thresholds*

Level	Coefficient	Cumulative Percent
Nothing	-0.30	43%
5 % of bill	0.30	57%
10 % of bill	0.97	72%
20 % of bill	.	100%

*Note: thresholds assume average income, average monthly bill, average age, where keeping rates low is important, and living in Maricopa County

Table E-4. Ordinal logistic model predicting categorical responses to "Would you be willing to pay an additional X% per month for your electrical bill now if it would create jobs in the energy industry for Arizona?" (N = 135 respondents from exogenous sample)

Predictor	Coefficient	Odds Ratio	p-value
Income ($10k)-Mean	0.00	1.00	0.866
Monthly Bill ($100) - Mean	-0.38	0.69	0.057
Age/10 - Mean	-0.15	0.86	0.119
Keeping rates low is not important	**0.88**	**2.42**	**0.033**
Non-Maricopa County	0.03	1.03	0.938

Estimated Thresholds*

Level	Coefficient	Cumulative Percent
Nothing	-0.51	37%
5 % of bill	0.11	53%
10 % of bill	0.77	68%
20 % of bill	.	100%

*Note: thresholds assume average income, average monthly bill, average age, where keeping rates low is important, and living in Maricopa County

Table E-5. Ordinal logistic model predicting categorical responses to "Would you be willing

to pay an additional X% per month for your electrical bill now if it would help develop new renewable energy technologies?" (N = 131 respondents from exogenous sample)

Predictor	Coefficient	Odds Ratio	p-value
Income ($10k)-Mean	0.00	1.00	0.573
Monthly Bill ($100) - Mean	**-0.39**	**0.68**	**0.032**
Age/10 - Mean	-0.07	0.93	0.455
Keeping rates low is not important	0.47	1.60	0.210
Non-Maricopa County	-0.33	0.72	0.386

Estimated Thresholds*

Level	Coefficient	Cumulative Percent
Nothing	-0.77	32%
5 % of bill	-0.35	41%
10 % of bill	0.37	59%
20 % of bill	.	100%

*Note: thresholds assume average income, average monthly bill, average age, where keeping rates low is important, and living in Maricopa County

APPENDIX F: LINEAR MODELS

The following tables present the linear models estimating the dollar amounts people would be willing to pay to address specific issues. The intercept is set at the adjusted average dollar amount that people would be willing to pay.

The first table (Table F-1) examines what people are willing to pay to assure a cleaner environment. The adjusted average was approximately $7. While there was no effect for income, people were willing to pay an extra $4 for every $100 increase in their bill.

Linear regression model predicting log-dollar responses to "Would you be willing to pay an additional X% per month for your electrical bill now if it would assure a significantly cleaner environment for Arizona?" (N = 131 respondents from exogenous sample)

Predictor	**Coefficient**	**p-value**
Income ($10k)-Mean	.0004478	0.893
Monthly Bill ($100) – Mean	.268835	0.016
Age/10 – Mean	.1199493	0.060
Keeping rates low is not important	.0342662	0.882
Non-Maricopa County	-.059266	0.785
EXP(Intercept)-1 (Adjusted Average)	4.3001277	0.000
R-Square	0.11	0.000
*Note: Intercept assumes average income, average monthly bill, average age, where keeping rates low is important, and living in Maricopa County		

Table F-1.

Table F-2 presents results from the linear model predicting the amount people would be willing to pay to ensure an uninterrupted supply of electricity. The average dollar amount here is about $5. Again, an increase in the monthly bill of $100 was associated with an increase of about $2.

Linear regression model predicting log-dollar responses to "Would you be willing to pay an additional X% per month for your electrical bill now if it would assure an uninterrupted supply of electricity for Arizona?" (N = 125 respondents from exogenous sample)

Predictor	Coefficient	p-value
Income ($10k)-Mean	.0046046	0.189
Monthly Bill ($100) - Mean	-.0115068	0.927
Age/10 - Mean	-.0898942	0.181
Keeping rates low is not important	.6509128	0.011
Non-Maricopa County	-.3695531	0.133
EXP(Intercept)-1 (Adjusted Average)	2.398908	0.000
R-Square	0.11	0.017
*Note: Intercept assumes average income, average monthly bill, average age, where keeping rates low is important, and living in Maricopa County		

Table F-2.

Table F-3 presents the model predicting willingness to pay for job creation. Here, the adjusted average is about $6, with a $3 increase for every $100 increase in a monthly bill.

Linear regression model predicting log-dollar responses to "Would you be willing to pay an additional X% per month for your electrical bill now if it would create jobs in the energy industry for Arizona?" (N = 135 respondents from exogenous sample)

Predictor	Coefficient	p-value
Income ($10k)-Mean	.0004489	0.893
Monthly Bill ($100) - Mean	.1794255	0.140
Age/10 - Mean	-.0570269	0.352
Keeping rates low is not important	.2163792	0.387
Non-Maricopa County	-.0613022	0.814
EXP(Intercept)-1 (Adjusted Average)	3.0852917	0.000
R-Square	0.0345	0.4686
*Note: Intercept assumes average income, average monthly bill, average age, where keeping rates low is important, and living in Maricopa County		

Table F-3.

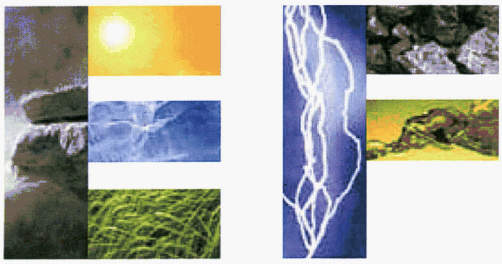
Finally, Table F-4 presents results for renewable energy. Here, the adjusted average was almost $7, with a $5 increase for every $100 increase in the monthly bill.

Linear regression model predicting log-dollar responses to "Would you be willing to pay an additional X% per month for your electrical bill now if it would help develop new renewable energy technologies?" (N = 131 respondents from exogenous sample)

Predictor	Coefficient	p-value
Income ($10k)-Mean	.0029592	0.277
Monthly Bill ($100) - Mean	.4779934	0.000
Age/10 - Mean	-.0700539	0.208
Keeping rates low is not important	.1107636	0.589
Non-Maricopa County	-.0198323	0.924
EXP(Intercept)-1 (Adjusted Average)	3.6514099	0.000
R-Square	0.1773	0.000
*Note: Intercept assumes average income, average monthly bill, average age, where keeping rates low is important, and living in Maricopa County		

Table F-4.

APPENDIX G: ENERGY BRIEFING BOOK



ENERGY FORUM

DECEMBER 4, 2010

BRIEFING BOOK

ASU Morrison Institute for Public Policy
ARIZONA STATE UNIVERSITY

ACKNOWLEDGEMENTS

Morrison Institute for Public Policy at Arizona State University and APS have partnered in a project to engage the public in a dialogue concerning Arizona's energy future and seek their input in making energy decisions. We would like to thank those who provided advice and guidance; we are grateful for their help in making this project a success.

COLLABORATIVE COMMITTEE MEMBERS

SANDY BAHR
Sierra Club, Grand Canyon Chapter

RICH BOWEN
Northern Arizona University

LEONARD CHEE
Navajo Nation

ELAINA CURLEY
Inter Tribal Council of Arizona

PATRICK DINKEL
APS

REBEKAH FRIEND
Arizona AFL-CIO

DAVID GETTS
SouthWestern Power Group

HERB GUENTHER
Arizona Department of Water Resources

JEFF GULDNER
APS

BILL HARRIS
Science Foundation Arizona

JASON HAYES
American Coal Council

KEVIN HIGGINS
Energy Strategies, LLC

JODI JERICH
Residential Utility Consumer Office

JOHN LEWIS
Inter Tribal Council of Arizona

KAREN NICODEMUS
KA Nicodemus Consulting

AMANDA ORMOND
The Ormond Group

ELLIOT POLLACK
Elliot D. Pollack & Company

JEFF SCHLEGEL
Southwest Energy Efficiency Project

KEN STROBECK
League of Arizona Cities and Towns

ELAINE WILSON
Inter Tribal Council of Arizona

NICOLE WOODMAN
City of Flagstaff

COREY WOODS
Phoenix Union High School District

ELLEN ZUCKERMAN
Southwest Energy Efficiency Project

CYNTHIA ZWICK
Arizona Community Action Association

ARIZONA PUBLIC SERVICE

SUSAN CASADY

MICHAEL OVERSON

MORRISON INSTITUTE FOR PUBLIC POLICY

DAVID DAUGHERTY

CJ HAGER

ERIC HEDBERG

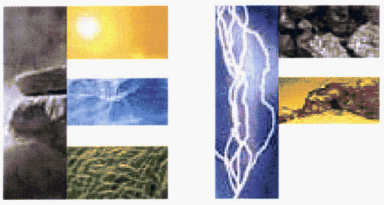
MONICA STIGLER

CHRISTINE TOTURA

NANCY WELCH

SUSAN HAAG, Arizona State University

MARTIN PASQUALETTI, Arizona State University

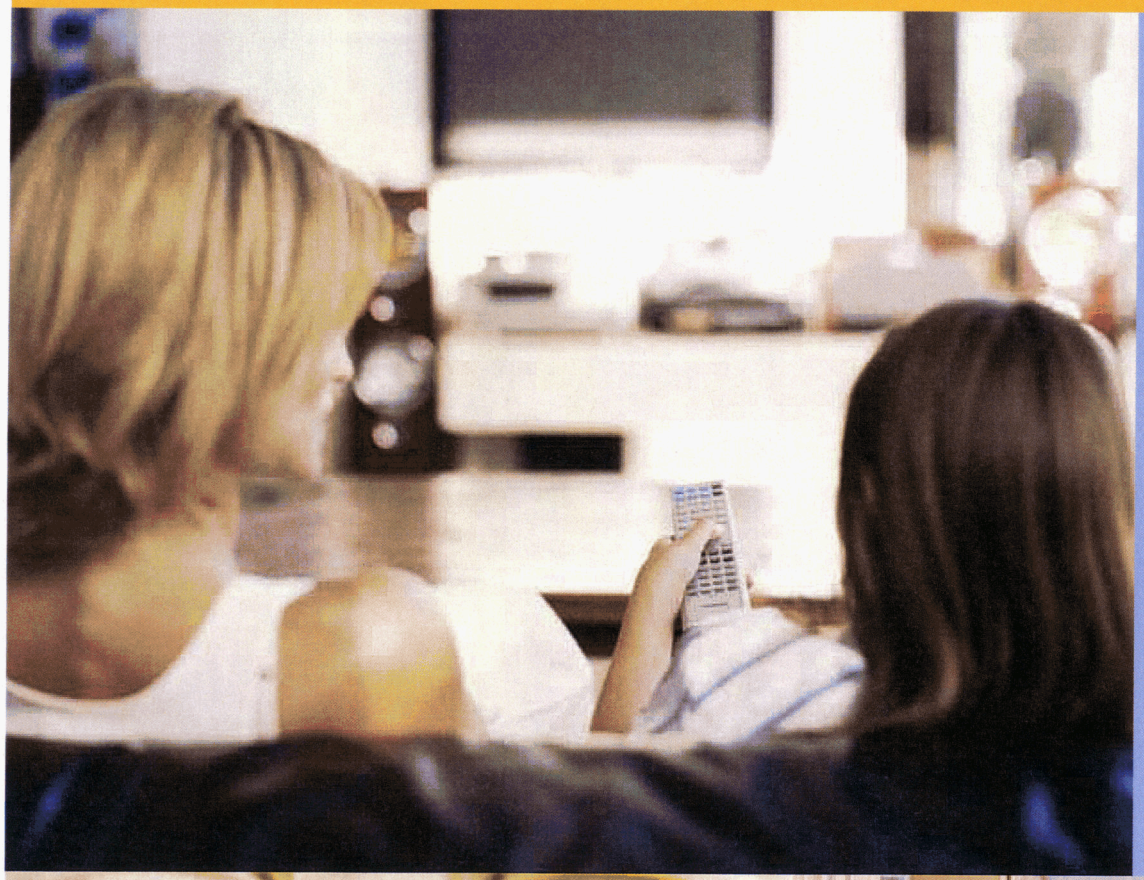


ENERGY FORUM

DECEMBER 4, 2010

BRIEFING BOOK

ASU Morrison Institute for Public Policy
ARIZONA STATE UNIVERSITY




HOME

CONTENTS

AN ESSENTIAL SERVICE

You don't have to be a scientist to grasp the major issues facing Arizona's energy policy. All you need is a little basic information—and maybe an alarm clock.

Alarm clock? One way of understanding electricity is simply to think about what happens at your home throughout the day, starting when that dreaded sound yanks you awake.

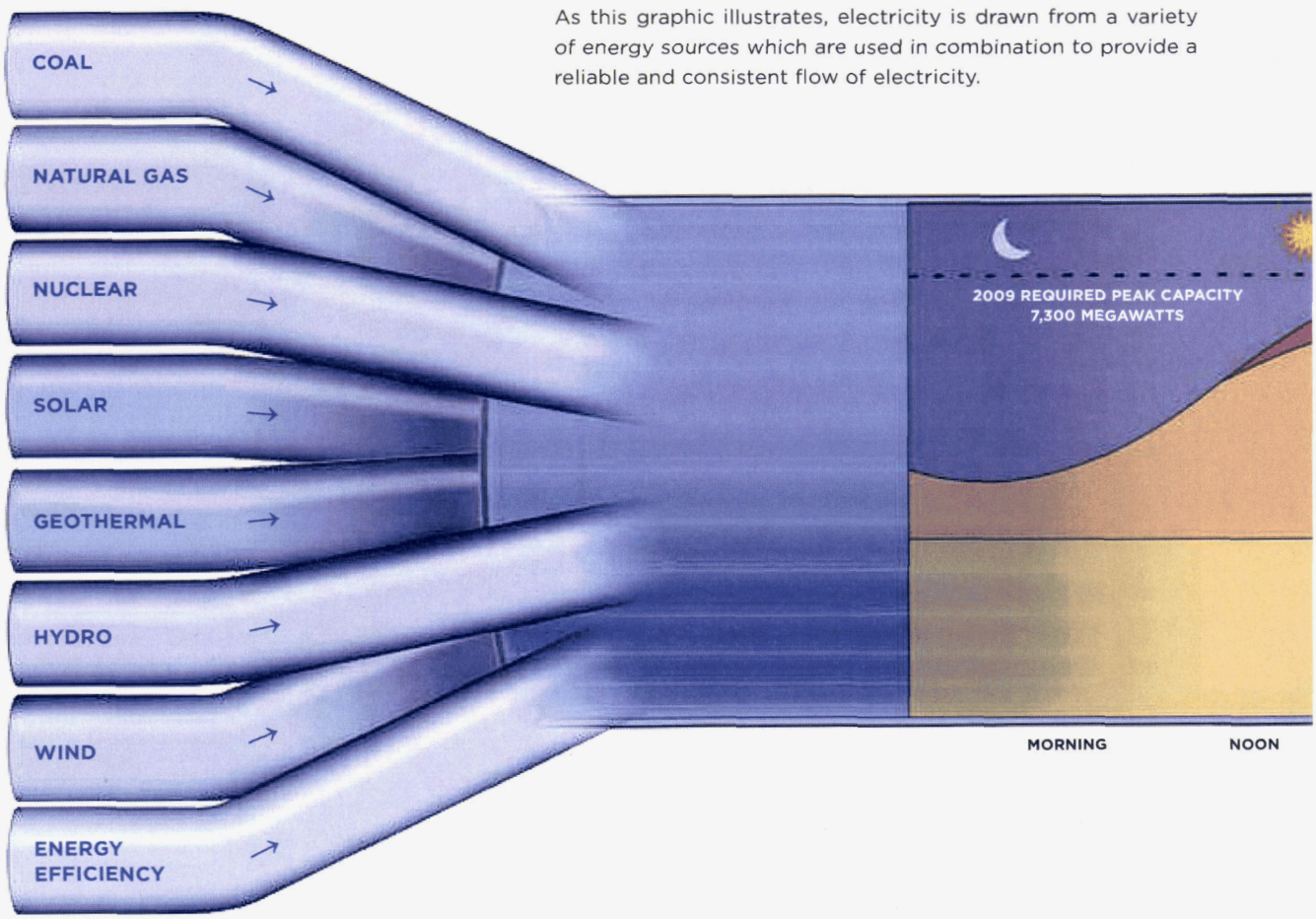
Your clock, along with your other gadgets and appliances, are the final step in a huge, carefully designed, constantly monitored system through which electricity is generated and delivered to homes and businesses throughout Arizona. It's also a system that you pay for, and one that is regulated by the Arizona Corporation Commission (ACC) and other government entities.

Maybe you're concerned about the state of Arizona's economy. Maybe you worry about the health of the environment. Maybe you're strictly focused on the size of your monthly energy bill. Maybe all of these. In any case, you should care about where your electricity comes from, how it gets to you and how much it costs. And you should have a say in it.

Figure 1. The Flow of Electricity

DETERMINING SUPPLY

As this graphic illustrates, electricity is drawn from a variety of energy sources which are used in combination to provide a reliable and consistent flow of electricity.



Energy exists in the natural world in forms such as lightning, combustible fuels (coal, natural gas, trees), wind, and sunshine. The process of converting energy from a natural form to electricity is called generation. It's usually done by coiling copper wire around a large shaft and spinning the shaft inside an even larger magnet. The spinning of the shaft makes the electrons in the coiled wire flow.

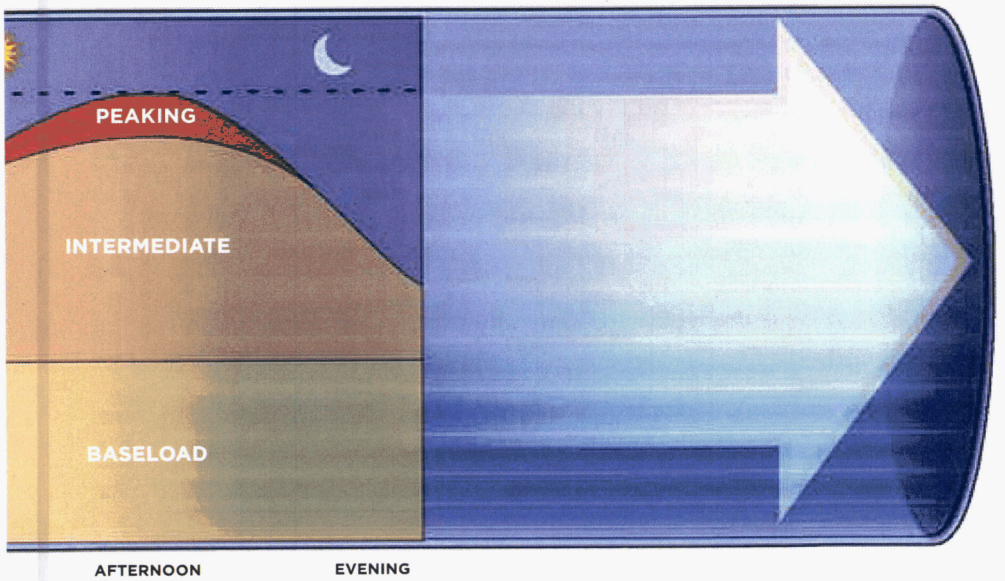
What exactly makes the shafts spin to generate electricity? Good question. Usually the shafts are driven by steam created from water heated with coal, natural gas, nuclear or from concentrated sunlight. The flow of water over a dam can also spin the shafts, as can wind.

While methods of generation work by spinning a coil of wire inside a magnet, one exception to this is electrical generation using photovoltaic solar "cells," such as those that might be on your roof. The cells contain layers of specially treated silicon, which, when struck by sunlight, create electrical current.

The electrical grid includes power plants that generate electricity and a system of powerlines that deliver electricity to your home or business. The power that runs your coffee maker may come from any of those sources or a combination. Regardless of source, the electricity produced is the same, and it has to be used when it is produced—it can't be stored with technologies we have today.

MANAGING SUPPLY & DEMAND

As energy demands ebb and flow throughout the day, the amount of electricity put into the system varies so that utilities can adequately meet consumer demands to Arizona homes and businesses.



And this is where our story really begins. Our focus is not so much on electricity itself, but on the methods, costs, reliability and broader impacts of the generation of electricity. Arizona Public Service (APS) currently generates power with mostly coal, natural gas, and nuclear fission at power plants throughout Arizona and in New Mexico. The generating capacity from renewable sources in Arizona, New Mexico and California is a small but growing part of the APS resource portfolio.

The minimum amount of electricity we use stays pretty stable across days, weeks, and months. The amount needed at low demand times, such as at night, is the minimum required, or **baseload**. Over the course of a year, the system-wide baseload is about one-third of that needed at peak times.

Sometimes, however, the demand for electricity rises for a period of time—such as when you and your neighbors hop into a hot shower, fire up the stove for breakfast, turn up the heat or cooling or even (sigh) mount the treadmill. This **intermediate** demand must be met by utilities by raising the amount of power coming to your home. At some point you go off to school, work or play, and electricity use shifts to businesses, offices, schools, and industry.

Another shift occurs when you and your family arrive home in the afternoon and start turning on air conditioners, computers, and everything else electric. As Arizonans know well, usage is greatest when the weather is most extreme, hot or cold. Okay, mostly hot.

Finally, there are brief periods when our use of electricity spikes upward sharply, such as during extremely hot summer days in Arizona. These are called **peak** periods. They require utilities to have enough generating ability, and power lines to carry it, to handle them smoothly. It's this peak period that dictates the total capacity for electricity flow.

Arizona's demand for electricity is large and getting larger, in part due simply to Arizona's population growth. There's also the fact that more people are living in bigger houses and using more electronic devices. Experts predict that Arizona's electricity needs may grow by as much as 50% over the next 15 years. Meeting that demand without blackouts, huge cost increases or other problems will take a lot of advanced planning—which is why we asked you to join us on December 4th.

Central to this planning process is making choices—these choices involve tradeoffs. The business of making electricity is even harder than it used to be. Determining what energy source to use to meet demand requires consideration of air, land impacts, jobs, water use, health, consumer costs, and time to develop the sources as well as determining how energy will be generated and distributed. That's why it is so important to consider the fundamental aspects of reliability and flexibility, including their tradeoffs, and find a balance among cost, diversity of energy sources, financial sustainability, and environmental impact. Balancing tradeoffs, in fact, is at the core of all public policymaking. Some ways of generating and delivering electricity cost more than others. Some have a harsher impact on the environment. Others are more reliable in all sorts of weather. Keep in mind three general questions:

1

What are the chief advantages and disadvantages of each source of electricity?

2

What is the best combination of energy sources for Arizona?

3

How much are we willing to pay for the combination we want?

BALANCING ELECTRICITY'S TRADEOFFS

A useful way to evaluate the various sources for electrical generation is to consider each one's cost, societal impacts and availability.

ELECTRICITY'S TRADEOFFS

Cost: How much will each source cost to generate and deliver electricity?

Societal Impacts: What impacts on society come from choosing different energy sources?

Availability: What energy sources can supply electricity when I need it?

I. Cost

Every energy source costs money whether it's to build the generating facilities, acquire fuel, generate the power, deliver it to customers or maintain the system. Adding new resources and equipment to meet Arizona's future energy needs will, in all cases, increase costs. This is due to the fact that all new energy sources cost more than our current energy sources. How much they increase depends on the amount of energy needed, the sources chosen to meet those needs, and their availability. Some sources, such as natural gas, have relatively small capital equipment costs but can be expensive to operate over time due to the cost of the fuel (natural gas). The cost of natural gas fuel can be hard to predict due to the volatility of natural gas prices. Nuclear generation, on the other hand, costs billions of dollars and years to launch, but has low, stable costs to operate after that.

These sources, along with coal, can be subject to changes in fuel costs and concerns about safety and waste disposal. Other factors also affect costs. One is the ACC's current requirement that Arizona utilities increase their share of electricity generated from solar and other renewable sources—called the renewable energy standard (RES). This may involve increased costs, at least initially, though it can result in stable costs and potential savings in the future. In addition, the cost of federal regulations for NOx, SOx, particulates, mercury, coal ash and greenhouse gases add further to the cost of energy.

Nobody likes a nasty surprise in their electric bill: Planning for Arizona's energy future demands careful attention to the relative costs and variability of different strategies. Energy efficiency incentives offered by utilities can help avoid or delay costs of fuel and construction of new generating plants.

Also, unlike the price of gasoline, which goes up and down with the international price of oil, the prices for coal and natural gas in the U.S. depend on domestic production and demand. APS and other Arizona utilities do not rely on foreign sources for those resources. Both of those sources are in plentiful supply in the U.S.

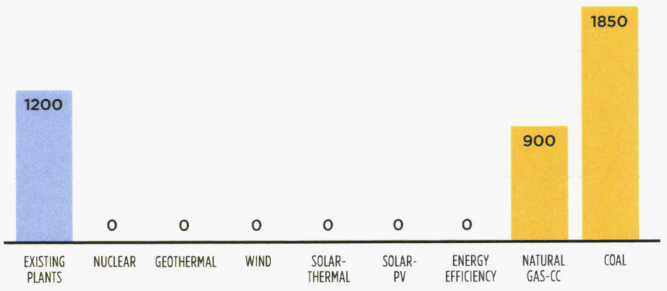
II. Societal Impacts

Electric generation affects society in vital ways that have nothing to do with your alarm clock. These impacts must also be evaluated and balanced against the need for a continuous flow of reliable, affordable power.

- **THE ENVIRONMENT.** Burning fossil fuels—coal or natural gas—to generate electricity releases gases and particles into the air that can be dangerous to health and could contribute to global warming and air pollution. Nuclear power creates radioactive waste products that could remain dangerous for centuries. Utilities factor into the cost of generating electricity such things as the cost of complying with environmental regulations and the cost of water they consume. However, "externalities," such as emissions that are not regulated, are not currently considered in setting electricity rates. Solar and other renewable sources have less environmental impact but they require changes to the operation of the electric system for wide scale use. Planning Arizona's energy future involves deciding how much of an environmental impact we're willing to accept.

Figure 2. Carbon Emissions from New Resources

In CO_2 lb/MWh, Ranked by Least to Most

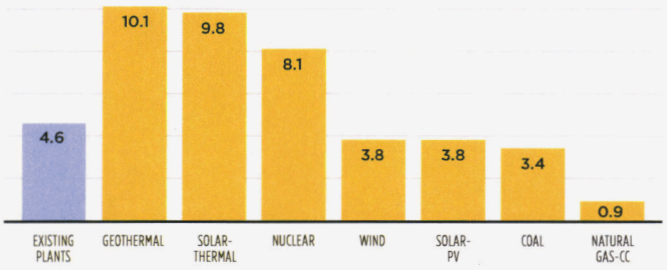


Source: Arizona Public Service, 2010.

- **THE ECONOMY.** Energy is the basis of all industry. Reliable and affordable electric power is critical to a healthy economy and a high quality of life. Additions or changes to Arizona's energy mix must be done in a way that maintains reliable sources of energy and that supports economic growth. No state or community wants to miss opportunities for landing new industries because of a lack of energy capacity or infrastructure or energy costs that are too high.

Figure 3. Potential Jobs of New Generation

In Jobs per 100,000 MWh, Ranked by Most to Least

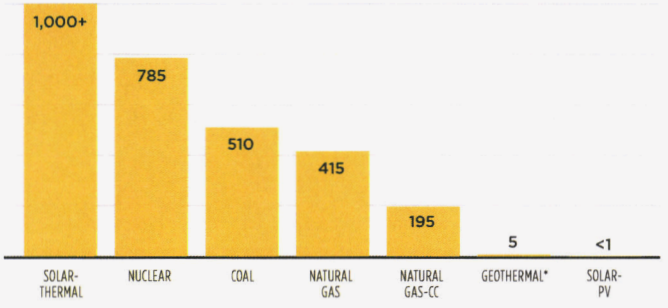


Source: Arizona Public Service, 2010.

- **WATER.** In Arizona, water is always an important consideration. That's particularly true concerning energy, because of the close relationship between the two. Energy is needed to make water available (think pumping) and water is needed to make energy available (think steam generation or cooling systems for generating equipment). Power plants overall use about 3% of the state's annual water budget, though some fuel sources use more than others (Figure 4). Energy efficiency helps to reduce energy use as well as water consumption.

Figure 4. Average Gallons of Water/MWh for Southwest-based Facilities

In Gal/MWh, Ranked by Most to Least



Note: Logarithmic scale. First-sale only.

Source: http://www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf

MEGAWATT HOUR (MWh) OF POWER

A **watt** is an instantaneous measure of energy output. A **megawatt**, another commonly used measure, is simply a million watts. Think about a typical 60 watt light bulb found in a home. A **megawatt hour**, a measure of energy used over time, is the amount of energy used to generate a million watts for one hour or enough energy to power over 16,000 60-watt light bulbs over that hour.

KILOWATT HOUR (KWh) OF POWER

A kilowatt hour is the amount of energy used to generate 1,000 watts for one hour, or enough energy to power 16 60-watt light bulbs over that hour.

III. Availability

The cheapest and most benign source of electricity is no good if it's not available when it's needed—availability is another key tradeoff to consider. This simply means that the electricity is there when you flick the switch, regardless of the weather or the time of day or year. In the longer term, it means having electricity keep flowing despite fluctuations in the economy, changes in demand, changes in climate, increases in population or other factors.

Today, the major question of availability concerns solar and wind power. Solar power generated from sunlight, of course, is less available during cloudy days, and is unavailable at night. But, Arizona has some of the best solar resources in the country and over 300 days of sunshine. Wind power doesn't work if the wind isn't blowing. Further, the technology for economically storing power generated from these renewable sources is not sufficiently advanced at present to compensate for their periods of unavailability. Planning for the future requires us to weigh these issues against the benefits the renewable sources offer. More renewable energy can be added to the electric system if there are changes made to the way the system operates. These system changes take time and can cost money to implement. However, many states, including Arizona, require utilities to develop renewable energy resource because of their benefits.

SO WHAT SHOULD BE IN ARIZONA'S ENERGY MIX?

As a consumer of electricity, you play a key role in balancing these tradeoffs. No one, including the experts, knows exactly what the future will hold. Even highly knowledgeable Arizonans disagree on which are the best energy choices. This booklet is meant to give you the information you need to understand how energy decisions are made, and how to keep reliable and affordable electricity flowing to communities like yours. At the Energy Forum, you will have the chance to learn even more about energy sources and generation, and to make your ideas and opinions known.

WHAT ARE ARIZONA'S RESOURCE OPTIONS?

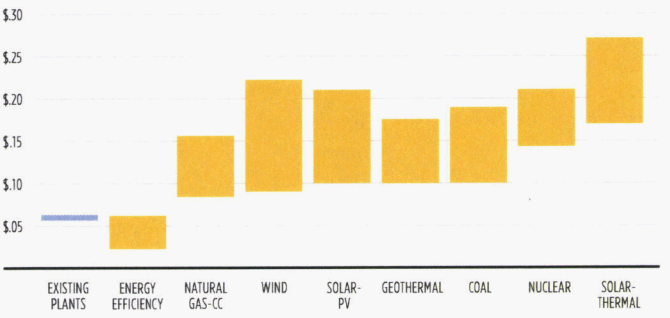
Given the basic overview of electricity's tradeoffs, let's review resource options. A great many sources of energy are being developed today, with many of them available to Arizona's communities.

At APS, generation makes up about 60% of the total cost of delivering electricity to you. The current average cost of generation is about six cents per kilowatt-hour. With the exception of energy efficiency, the cost of all new resources will exceed today's cost of generation. That means that the addition of new resources to meet Arizona's future energy needs will cause electric prices to go up. How much prices go up will depend on, among other things, the amount of energy needed and the types of resources chosen to meet those needs.

Figure 5 shows the potential cost for APS resource options along side the current cost of APS generation. The floating bars represent the upper and lower ranges of the cost for each resource option. The ranges reflect the total cost of producing power and sending it to APS' electrical system, along with the associated uncertainties which vary for each option. The uncertainties relate to fuel prices, the cost of construction, carbon prices, federal incentives, and transmission costs, as examples. Each resource performs differently, so you can't simply compare or swap one for another. APS looks to purchase the best resource to meet customer needs at the best price. As you can see, with the exception of energy efficiency, all the resource options have costs well above the average cost of APS' existing generation.

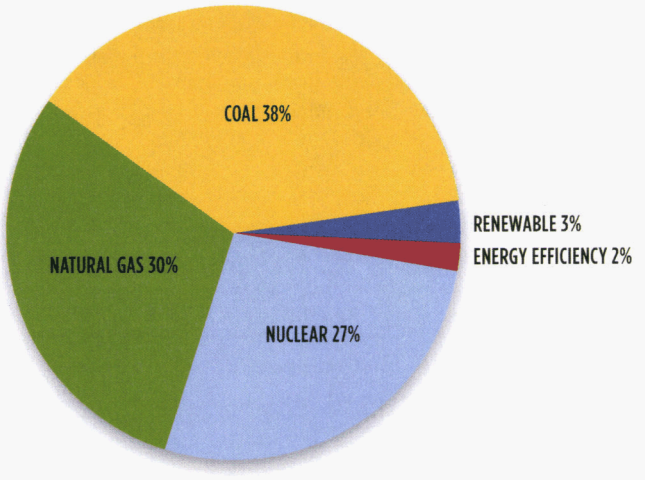
Figure 5. 2010 Costs of New Generation

In Cents/kWh



Source: Arizona Public Service, 2010.

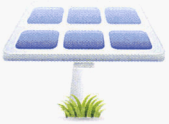
Figure 6. Current APS Energy Mix



Source: Arizona Public Service, 2010.

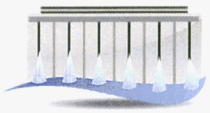
Now let's look further at each of the major power sources that are being used or may be used in Arizona in the future. We'll keep the focus on the three issues of **Cost**, **Societal Impacts** and **Availability**. This will illustrate some of the tradeoffs that must be considered in choosing some sources over others, or a mix of sources in various combinations.

COMPARING POWER SOURCES

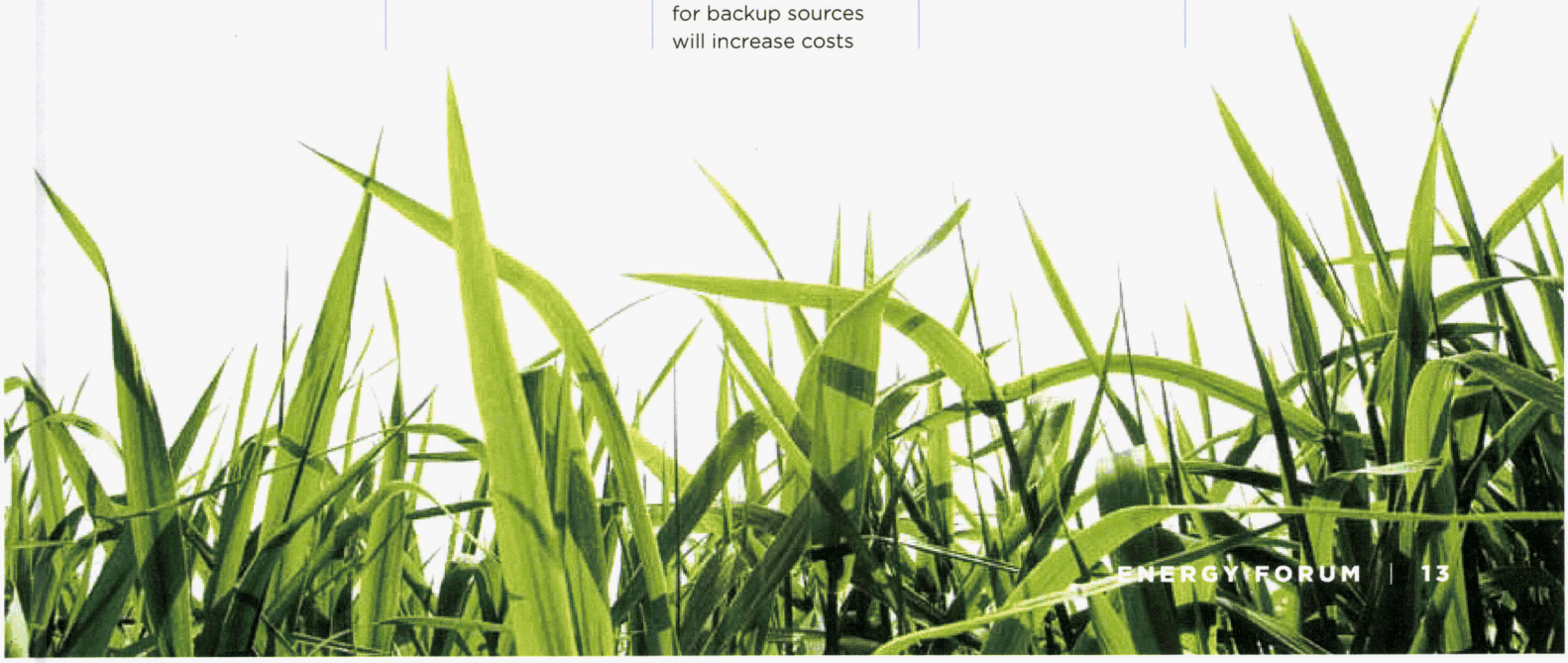


	COAL	NATURAL GAS	NUCLEAR	SOLAR
Process	Heat created from burning coal creates steam used to turn turbines	Heat created from burning natural gas creates steam used to turn turbines	Heat created from splitting uranium atoms creates steam used to turn turbines	Heat from focused sunlight creates steam used to turn turbines, or sunlight reacts with silicon to create electricity
Availability	Abundant, reliable, non-renewable	Abundant, reliable, non-renewable	Reliable, non-renewable	Renewable but available only during daytime hours, will require backup from other sources
Societal Impacts	Produces greenhouse gases and other pollutants, environmental damage from mining, and potential health effects from pollution; provides many jobs	Emissions are less polluting than coal but still produces greenhouse gases, and potential health effects from pollution	No harmful air emissions; waste products remain radioactive for centuries; safety and security concerns remain among public; uses a large amount of water; provides many jobs	No air emissions or waste products, high water use for some technologies, no water use for others
Cost	Inexpensive source to operate; pollution regulations increasing the expense to build and operate	Inexpensive source to develop; transportation costs; pollution regulations increasing costs; fuel prices can fluctuate	Very expensive to build, relatively inexpensive to operate, waste issues and safety requirements could raise costs	No fuel costs but high cost to build, high land use and high water use for some technologies, need for backup sources will increase costs

SOME POINTS TO KEEP IN MIND



GEOTHERMAL	HYDRO	WIND	ENERGY EFFICIENCY	
Hot water and steam from the earth's interior turns turbines	Flowing water, usually associated with dams and rivers, turns turbines	Wind turns turbines	Taking steps to reduce energy use	**Process**
Few known sources in Arizona, renewable	Reliable, but limited new sources in Arizona, renewable	Renewable, only available when wind blows, requires backup from other sources	Depends on the application and near-term/long-term view	**Availability**
Low emissions, high water use; environmental impact depends on quality of water that comes out of the earth.	Low emissions, can coexist with other reservoir uses, public concerns about impact of dams on ecosystem	No air emissions, no waste, some concerns about impact on habitat and property values; no water use; visual impacts	Can reduce energy needed from sources that produce emissions and use water; some aspects require changes in consumer lifestyles	**Societal Impacts**
Relatively expensive to build and operate, no fuel cost, stable price	Expensive to build, low operating costs, high delivery costs from remote locations	No fuel costs but high cost to build: low operating costs, high delivery costs from remote areas, need for backup sources will increase costs	Seeks to reduce costs across all sources through efficiency; cost of future efficiency is uncertain	**Cost**



COAL

Coal has long been the primary energy source behind the nation's industrial economy. Coal is the most common source for electricity. Today, coal accounts for 39% of electricity in the APS service area and 50% in the U.S.[1]

Cost

Coal is historically one of the least expensive and most plentiful resources to convert into electricity. This is partly due to the fact that coal plants tend to run consistently and reliably. However, costs to build and operate a coal plant have risen substantially and will likely rise further in the future as environmental impacts of generating electricity from coal are recognized and controls are incorporated into government regulations.

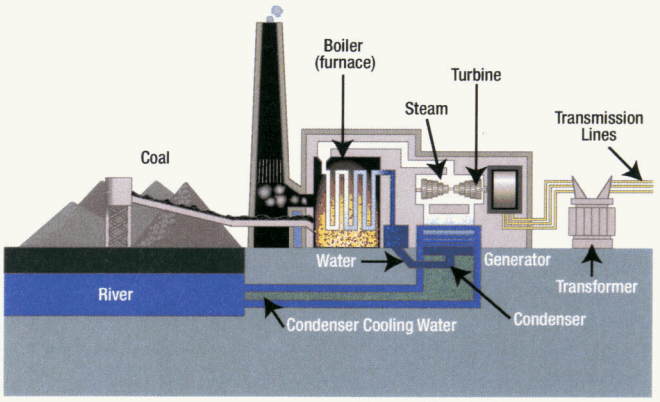
Societal Impacts

Mining for coal can damage the environment and cause air and water pollution. The burning of coal causes air pollution and the release of toxic emissions could affect public health. In addition, existing coal power creates about half of the greenhouse gases[2] in the U.S.[3] and, thus, poses a substantial environmental challenge. Coal needs water to be processed into fuel and still more water for cooling a coal-fired generating plant. New advances in "dry cooling" can reduce coal's dependence on water, but these improvements will cost more and will decrease the efficiency of the power plants. Jobs are also an important consideration for coal plants as they create a significant employment base for some rural communities in Arizona.

Availability

Coal reserves are abundant in the U.S. Generation from coal is not subject to time of day, weather, or seasonal variation.

Figure 7. Coal-Fired Power Plant



Source: Tennessee Valley Authority.

DRY COOLING

This is a method of removing heat from a system by directly transferring the energy from a hot fluid to the atmosphere by convection (using tubes or fins, for instance; some stereos and other electronic equipment use this method but on a smaller scale).

NATURAL GAS

Natural gas has long been used as a source of power and is expected to be the fuel of choice for about half of the new power plants in the U.S. over the next 20 years.[4] Natural gas provides about 25% of electricity in the U.S. and about 27% in APS territory, mostly through combined cycle units.

Cost

The costs of constructing natural gas plants are about a third that of new coal plants. Because natural gas plants are relatively clean they can often be located fairly close to metropolitan areas. This ultimately lowers the cost of delivering power to homes and businesses. Volatile natural gas prices, however, are another important issue that adds risk to the cost of gas generation and may impact customer bills.

COMBUSTION TURBINE NATURAL GAS PLANT

A combustion turbine natural gas plant burns fuel to turn a turbine to drive a generator.

COMBINED CYCLE NATURAL GAS PLANTS

These plants utilize waste heat from combustion turbines as an additional resource for generating elecricity that makes this technology more efficient.

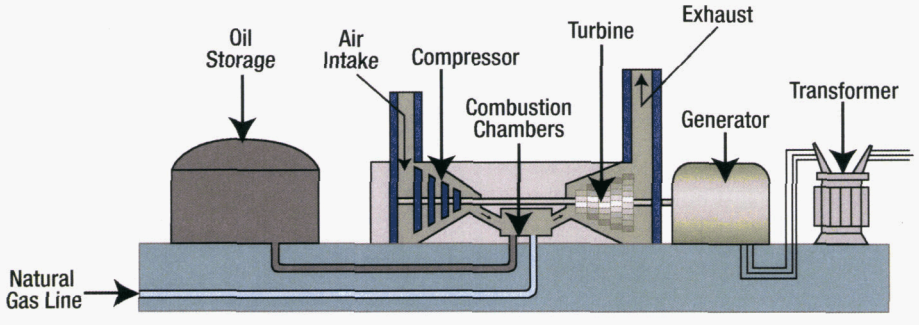
Societal Impacts

Greenhouse gas emissions from natural gas combined cycle plants are approximately half that of a coal plant. Gas plants do, however, produce oxides of nitrogen at a higher rate than coal plants. There are little or no sulphur dioxide emissions. Natural gas generating plants use water for cooling. New advances in "dry cooling" can reduce use of water, but these improvements will cost more and will decrease the efficiency of the power plants.

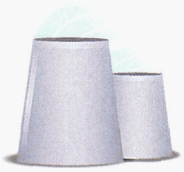
Availability

Natural gas is abundant in the U.S. and Canada, although debate about how or even whether to reach it remains ongoing. Generation from natural gas is not subject to constraints of time of day, weather, or seasonal variation. Because it is relatively easy to start and stop natural gas power plants, natural gas is often used as a supplemental resource to meet demand for electricity through the course of a day. It's the most economic technology to compliment intermittent resources like wind and solar.

Figure 8. Combustion Turbine Natural Gas Plant



Source: Tennessee Valley Authority.



NUCLEAR

Arizona is home to the nation's largest nuclear power plant, Palo Verde. APS is one of the eight owners of this facility and is its operator. Nuclear energy provides about 20% of U.S. electricity[5] and 27% for the APS service area. Nuclear is the only generation source, other than renewables, that can provide energy without greenhouse gas emissions, mercury, or other pollutants.

Cost

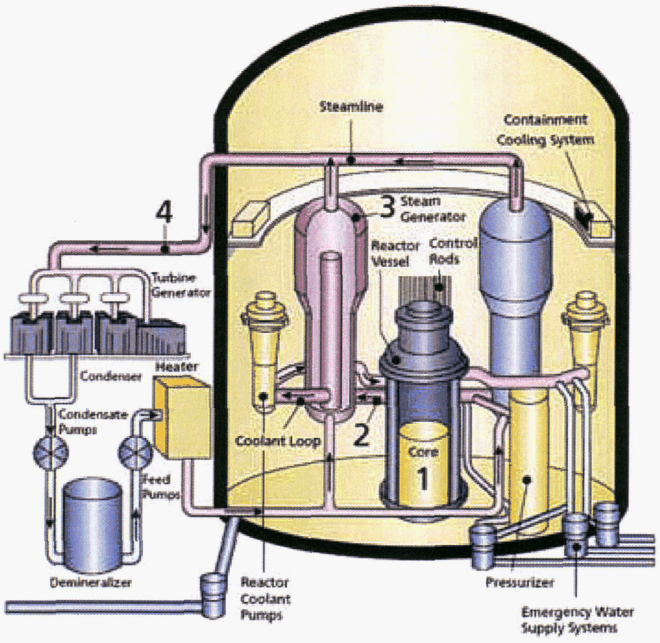
Nuclear resources have the benefit of low operating costs. While the cost of building a new nuclear facility is high, new federal loan guarantees and private sector technology developments may help in making new nuclear plants more feasible. Currently, there is limited capital available from the private sector for nuclear power plant construction and hesitancy to proceed without full loan guarantees. Since the construction of Palo Verde, there have been no new nuclear plants built in the United States. Because it has been over 20 years since the U.S. has built a new nuclear power plant, the cost for the next generation of nuclear power plants is uncertain. Costs are impacted by safety requirements, water use, spent fuel disposal, and taking down the plant at the end of its useful life.

Societal Impacts

Today the disposal of spent nuclear fuel remains a concern. Spent fuel is safely stored at the plant site. While federal efforts to develop a central storage site have been debated, none are currently available. In addition, nuclear plants use a large amount of water for cooling. Nuclear generation also requires the mining of uranium as a fuel source with environmental impacts similar to mining for other resources. However, the radioactivity associated with uranium ore requires some special management in addition to the general environmental controls of any mine. Nuclear energy is the most heavily regulated of electric resources, and a highly skilled workforce is required to construct, operate, and maintain a nuclear plant. Nuclear power provides a significant employment base.

Figure 9. Pressurized Water Reactor

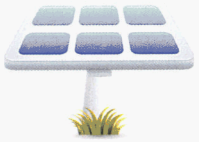
Nuclear reactors are complex and require a large amount of water for cooling.



Source: U.S. Nuclear Regulatory Commission.

Availability

Nuclear power plants can operate around the clock, regardless of weather or season.



SOLAR

Arizona's abundant sunshine and wide open spaces make solar a logical source of energy for the state. Solar energy can be converted into electricity using photovoltaic panels (PV) or by using a thermal solar power system. PV systems can be small scale, private systems or large scale utility systems. Thermal technologies are for large scale applications.

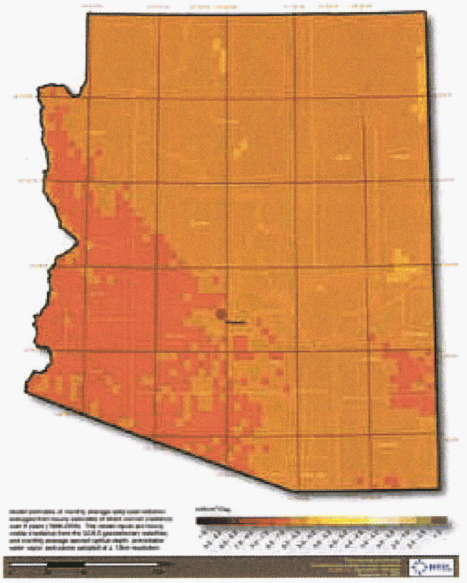
Cost

Although fuel costs are essentially zero, current building costs for new solar energy facilities can be significantly more than a natural gas combined cycle plant. However, the cost of energy from a solar plant is stable and will not increase significantly over time. In addition, a great deal of land is needed for solar thermal plants that capture sunlight and focus it to heat liquid. Photovoltaic panel installations also require lots of land or other surface area, although smaller sized community solar projects are also possible and can use brown fields or other disturbed or degraded land. Another cost is the need for alternative power sources when solar availability decreases. The Federal government currently provides significant tax incentives to encourage development of solar and other renewable sources. APS and other Arizona utilities encourage the placement of solar photovoltaic panels on rooftops.

Societal Impacts

Solar technologies emit no air polution, toxic emissions, or greenhouse gases, and have the potential to help reduce the use of natural gas. However, some solar technologies require a substantial amount of water, a limited resource in Arizona. Solar PV consumes only a small amount of water to wash the panels. Distributed solar, such as the placement of solar modules on rooftops is also a resource. It requires no water and emits no pollution.

Figure 10. Solar Energy Potential by Region



Source: This map was generated by the National Renewable Energy Laboratory for the U.S. Department of Energy.

Availability

Because solar power is dependent on sunlight, solar power does not operate at night, and is less effective on cloudy days. In order to balance out solar power's intermittency, other resources such as natural gas resources must also be available. While the sun is shining, solar power is available, but the fact that the sun does not shine all day long every day remains an important limitation for this resource option. A bright spot for solar is that energy storage can be added to solar facilities so some electricity can be available during hours when the sun is not shining.

GEOTHERMAL

Geothermal is energy that is harnessed from the Earth's underground heat. Arizona has few known locations with high-temperature geothermal resources. This limits the development of geothermal to make electricity in Arizona and forces utilities to look out of the state for this resource.

Cost

While not as high as for solar, current building costs for geothermal can be higher than those of traditional energy sources. The Federal government currently provides significant tax incentives to encourage development of this and other renewable sources. Some geothermal locations offer better forms of energy than others.

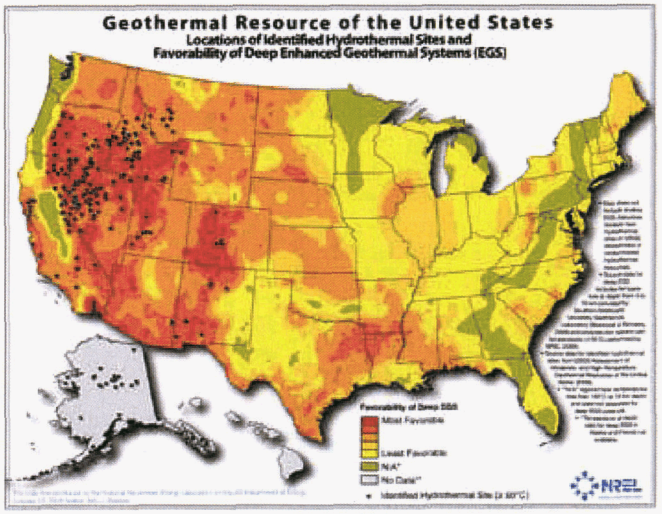
Societal Impacts

Geothermal power plants produce a smaller amount of greenhouse gases than fossil fuel facilities.[6] Heat and water are the only resources needed. The environmental impact of geothermal power plants depends on the characteristics of the water and steam brought up from the earth. Heavy metals and other hazardous materials can be brought up that must be handled appropriately. Sometimes this includes returning that waste to the underground source along with the now-cooled water. In any case, the cost impact of handling hazardous materials can be substantial for some geothermal plants but much less for others.

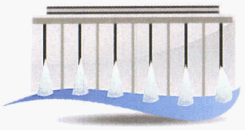
Availability

Geothermal is another resource that is available 24 hours a day, 7 days a week, because the Earth never stops producing heat. Because it is always available, geothermal can be attractive as a source of baseload electricity.

Figure 11. Geothermal Sites in the U.S.



Source: This map was generated by the National Renewable Energy Laboratory for the U.S. Department of Energy.



HYDRO

Hydro facilities use a storage system in which water is collected in reservoirs created by dams, then released as needed to spin turbines and generate electricity. This process is highly efficient with a 90% conversion rate to actual energy; the typical rate for a fossil fuel plant is between 37% to 39%.

Cost

The operating costs for hydro facilities are relatively low compared with other sources. Remote locations mean electricity must be moved over long distances, keeping construction costs for delivery systems high.

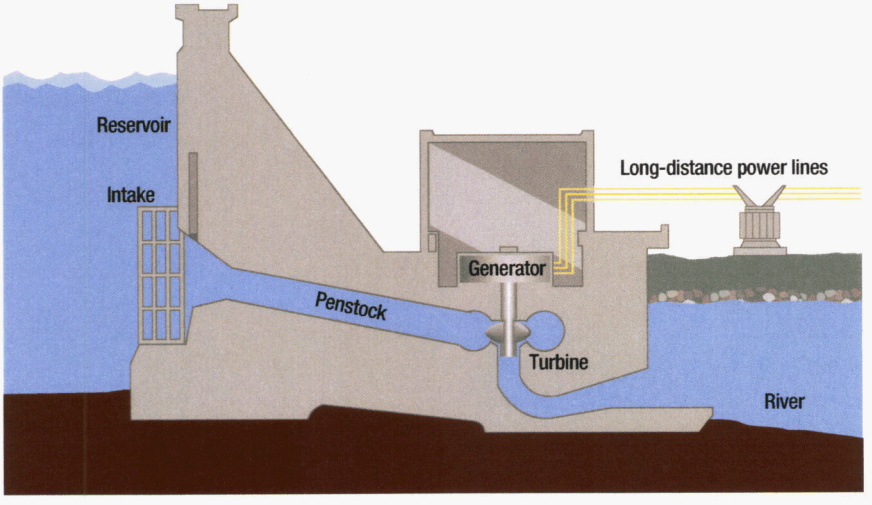
Societal Impacts

No emissions are created through hydro technology. Also, the reservoirs that each dam creates, such as Lake Mead and Lake Powell in Arizona, also serve as recreational destinations for residents and tourists. These storage sites allow water resource managers to address problems of supply and demand in communities. However, the creation of a reservoir can flood upstream land and permanently alter wildlife habitat. Arizona's hydropower reservoirs lose an average of approximately 56,000 gallons of water to evaporation for each MWh of electricity generated.[7] This means that, despite the efficiency of this resource, the dry, hot Arizona climate pulls a lot of the water saved for hydro energy generation back into the air which lessens the overall efficiency of this resource.

Availability

Hydro plants can operate around the clock regardless of season or short-term weather patterns. With few rivers or other flowing water resources in Arizona, new capacity for energy generation from hydro is not possible for APS.

Figure 12. Hydroelectric Dam



Source: Tennessee Valley Authority.

WIND

Advances in technology have helped with the expansion of wind as a source of energy worldwide. Potential sites for wind energy production are often in remote locations where transmission infrastructure will need to be built.

Cost

The amount of wind energy costs vary by geographic region. In some cases wind energy can be the lowest cost renewable energy resource and even compete with new natural gas generation. Due to its intermittency, other resources will need to be available when the wind is not blowing. "Wind farms" may be very large, but can be operated by a small staff, keeping operating costs low.

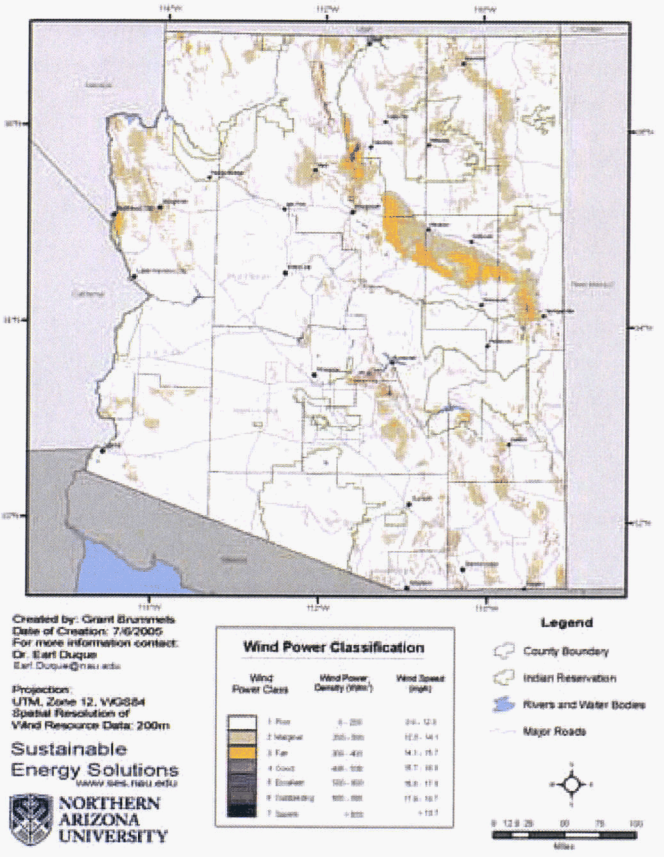
Societal Impacts

Wind turbines can be placed in almost any location including on land that might be unsuitable for other purposes. Often wind farms can also support agricultural uses. Wind energy uses no water and produces no air pollution, toxic emissions or greenhouse gas emissions. Wind turbines are starting to be manufactured in the U.S. creating jobs and economic benefits in certain regions.

Availability

Locally, wind resources are greatest in spring, a time of low energy demand in Arizona. Given wind's intermittent nature utilities must use complementary resources to meet customer needs. A few homeowners have installed small wind turbines on their property for private use.

Figure 13. Arizona Average Annual Wind Resource



Source: Northern Arizona University.

ENERGY EFFICIENCY

One of the major opportunities for a sound energy policy is reducing energy waste. Waste can occur in obvious ways—the kids run out the back door and leave it open; your old house lacks insulation and "leaks" air around the windows and doors. It can also happen when you don't do things—such as replace old appliances or inefficient light bulbs.

When the electricity grid nears its maximum capacity, utilities have a choice: they can build additional power plants or can invest in helping their customers use less electricity through more efficient lighting, air conditioning or heating, or converting to more efficient appliances or equipment.

Cost

Energy efficiency is currently the lowest cost energy resource. People invest in energy efficient upgrades to get the same or better performance while using less energy. Utilities encourage customers to be more energy efficient because it is less expensive than building new power plants. New plants will still be needed, but may be deferred to a later time. Utilities spread these costs among all customers just as they would the cost of developing additional generating capacity.

Societal Impacts

By making investments in energy efficiency Arizona can avoid the negative impacts and costs of other resources. Money saved by those who adopt energy efficiency can be used for other purposes that can strengthen our economy. Also, construction jobs can be created as demand for equipment installation increases.

Availability

Energy efficiency adoption will increase as utilities promote it and customers become accustomed to it. New technologies and demand-side management improvements are helping customers use less energy, while not sacrificing service level. Since energy efficiency is, by its very nature, reducing customer demand for energy, the availability of this resource follows a pattern similar to how customers would have used energy. For example, APS has a program that encourages homeowners to install energy efficient air conditioning units. The energy available from investing in this program depends on how much energy is saved by using the more efficient units. New technologies and enhanced management can make energy efficiency a good resource for meeting some of Arizona's future energy demands.

APS's current **Residential** Energy Efficiency programs include:

- Air Conditioner Rebate Program
- Compact Fluorescent Light bulbs (CFLs)
- Duct Test and Repair Rebate
- APS ENERGY STAR® Homes
- Home Performance with ENERGY STAR®
- Energy Efficient Pool Pumps & Seasonal Timers
- Refrigerator Recycling Program

APS's current **Business** Energy Efficiency programs include customized incentives as well as:

- Lighting
- HVAC
- Information Technology
- Motors
- Pumps
- Refrigeration

NEXT STEPS – NOW WHAT?

Now that you have had the chance to learn about where electricity comes from, what goes into making it, and how it is delivered to your home, think again about the three questions we started with:

1. What are the chief advantages and disadvantages of each source of electricity?

2. What is the best combination of energy sources for Arizona?

3. How much are we willing to pay for the combination we want?

As you can see from reading this booklet, a lot goes into answering these questions for you, your family, and your neighbors.

You will have the opportunity to revisit the information in this booklet at the Energy Forum on December 4th. There, you will be asked to share your thoughts, opinions, questions, experiences and concerns about energy choices that you or your community will make in the future.

Your participation will be valuable for us to understand what is important to energy consumers like you!

For more information, please visit the Morrison Institute Energy Forum website: MIEnergyForum.asu.edu

ENERGYFORUM

DECEMBER 4, 2010 | 7:30am-4:00pm
Scottsdale Resort & Conference Center

Endnotes

1 APS and Edison Electric Institute.
2 Energy Information Administration.
3 National Energy Technology Laboratory.
4 Johnson, Jean and Scott Bittle, Who Turned Out the Lights?, Public Agenda, 2009.
5 Energy Information Administration and Nuclear Energy Institute.
6 Geothermal Explained, Energy Information Administration.
7 Arizona State University, M. Pasqualetti Fact Sheet.


Hld 76
Time
Temp

PREPARED BY

ASU Morrison Institute for Public Policy
ARIZONA STATE UNIVERSITY

411 NORTH CENTRAL AVENUE, SUITE 900, PHOENIX, ARIZONA 85004-0692, 602.496.0900
MORRISONINSTITUTE.ASU.EDU

SPONSORED BY

APS